News for Jan.-Mar. 2019

SCIENCE AND TECH.

THE CRUX OF THE HINDU

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Aspirant Forum

AN INITIATIVE BY UPSC ASPIRANTS

aspirantforum.com
SCIENCE AND TECH.
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Aspirant Forum is a Community for the UPSC Civil Services (IAS) Aspirants, to discuss and debate the various things related to the exam. We welcome an active participation from the fellow members to enrich the knowledge of all

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About the 'CRUX'

After the success of our monthly magazine The Crux of The Hindu and PIB, we are introducing a new and convenient product, to help the aspirants for various public services examinations. Today, the knowledge of the Current Affairs (Science and Technology) constitutes an indispensable tool for all the recruitment examinations. However, as per the examinations are concerned, it is quite tedious task to memorise each and every news. Moreover, every news as given in magazines and newspapers may or may not be relevant from exam perspective which forces the candidates to spend a quality time in extracting useful matter and framing notes. This problem of aspirants strikes our minds and made us to think for a sure shot solution as a result of which our experts have come out with the unique magazine of Science and Technology, Crux of Science and Technology. This trimonthly convenient product is going to save our aspirants' time. The whole concept of the CRUX is to provide you with a summary of the important news and current affairs, from an exam point of view. By reading the CRUX, you will be able to save your precious time and effort, as you get all the relevant matter in a summarized and convenient form. The Crux is particularly helpful for the Civil Services, Banking, SSC and other exams that have a current affairs section. The material is being provided in such a manner that it is helpful for both- objective and descriptive sections. Our aim is to help the candidates in their effort to get through the examinations. Your efforts and dedication inspire us to keep going. It is our sincere effort to make your journey easier.

Best Wishes
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The Hindu

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How an Israeli craft seeks to capture the moon

With less of a fuss than I might have expected, a remarkable competition ended last year. The interesting thing about it? There was no winner. In fact, the competition ended precisely because there was no longer a chance that there could be a winner.

Perhaps you know that I'm referring to the Google Lunar X Prize competition. It was intended as a catalyst for private space exploration, as opposed to efforts by national agencies like Isro or Nasa. Specifically, the challenge was to land a rover on the moon, have it travel 500m and send home images and video. The first privately funded team that could do this by 31 March 2018—a deadline that had been extended twice—would win the prize, $30 million.

Several teams from around the world entered the competition. In early 2017, five finalists were announced: among them, Team Indus from Bengaluru. But in January 2018, the competition was shut down because none of these five would be able to meet the 31 March launch deadline.

Competition or not, some of the teams decided to keep their efforts going. Two of those are Team Indus and SpaceIL from Israel—and on 21 February, SpaceIL's moon lander shot into space atop a Space X Falcon 9 rocket. So if all goes well, SpaceIL's craft, Beresheet (Hebrew for "genesis" or "in the beginning"), will soon land on the moon.

Though what's interesting is what "soon" means here. In 1969, the USA's Apollo 11 took about four days—launch to landing—to reach the moon. In 1970, the USSR's Luna 17 landed there about a week after taking off. In 2013, China's Chang'e 3 took five days to reach and settle into orbit around the moon, and landed a week later. Beresheet, by contrast, will only attempt to land on the moon on 11 April, nearly two months after blasting off. So while the moon is just over 350,000km away when it is

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closest to us, by the time Beresheet lands there, it will have travelled about 6.5 million km.

Why so long, and what will Beresheet be doing for all those weeks?

One reason for the long travel time is that Beresheet shared its ride into space with an Indonesian satellite and an experimental American craft. This is space exploration Uber Pool-style, then, which is also how SpaceIL's co-founder Yonatan Winetraub described it just before the launch. The big advantage: it costs significantly less than a dedicated rocket would—and especially for a small private effort, price matters a great deal. The downside is that while a dedicated rocket might have set Beresheet directly on course for the moon, this Falcon 9 launch only put Beresheet into orbit around the earth, like it did the two ride-sharers.

What happens after that, so that Beresheet can take its shot at the moon, is up to SpaceIL's engineers.

Yet mathematically, that's a particularly interesting part of this exercise. For there are plenty of objects—the International Space Station (ISS), satellites and assorted space junk—that orbit the earth all the time. None of them are going to shoot for the moon.

What makes Beresheet different, even as it orbits the earth for several weeks? The difference is that Beresheet's orbits will get steadily wider, and that's entirely by design.

To understand this, think of something we've all done as kids—tie a stone to a string and whirl it around our heads. If you hold the string tight and keep up the whirling, the stone will keep going round and round indefinitely at the same speed. Though you'll agree that you have to keep up the whirling; stop, and the stone will slow and drop down.

Now imagine that at one point in each pass around your head, you let the string out a little, and then pull it back in later. When you let the string out,

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the stone moves further away and slows down; when you pull it back in, it moves back towards you and speeds up. You need to be careful not to let out too much string or again, the stone will slow so much that it drops down. If you don't want this to happen, you'll have to speed up your whirling each time you let string out.

This is a passable model of what will happen with Beresheet. Gravity keeps it in orbit, as it does every other object that whirls around the earth, acting like the string you've tied to your stone. But that's where the parallel to satellites and the ISS ends. With each orbit, Beresheet will fire its engine, which sends it sailing just a bit further from our planet than on its previous orbit. Then it swings back towards the earth, picking up speed as it approaches and circles us. Fire the engine again and… well, as you can imagine, this process results in ever-larger orbits.

In effect, Beresheet uses the earth's gravity as a slingshot, building up speed and increasing its distance from the earth with each orbit. Our own Mangalyaan did much the same a few years ago, as I explained in my column "Mars, here we are". Eventually, Mangalyaan's orbits got so elongated that it could effectively escape earth's gravity and set a course for Mars. Over the next three weeks, Beresheet's orbit will elongate similarly, until it spans close to 400,000km.

When that happens, the orbit will have ranged past the moon. That is, the expansion of Beresheet's orbits has been calculated precisely so that it will intercept the moon at a particular convenient time about three weeks from now. The precision is necessary because the moon has an elliptical orbit which takes it from a low of about 350,000km to a high of about 410,000km from us. So it makes sense to plan this encounter with the moon for the point in its orbit when it is closest to us. As you read this on 1 March, the moon is about 400,000km away; on 20 March, it will have swung substantially

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closer, to just 359,000km away.

Aside: If you remember, there was mention of a "supermoon" on 19 February — because on that day, the moon was under 357,000km away, its closest approach till 2024. Beresheet did not launch in time to take advantage of that proximity, which is why it is shooting for 20 March.

What will begin on 20 March is, as Beresheet's Israeli team describes it, the process of "lunar capture". I like the bravado of that term, the very vision of a tiny spacecraft "capturing" a gigantic rock out there in space. Of course it's more accurately described as a "Beresheet capture", because it is Beresheet that will eventually start orbiting the moon. Then again, we would say that only because Beresheet is much smaller than the moon. In truth, when we think of one object orbiting a second, we might equally well describe the phenomenon as the second object orbiting the first, whatever their sizes are. So "lunar capture" fits after all.

So on 20 March, Beresheet will fly beyond the moon on its elongated earth orbit. By then, the craft will feel the moon's gravity more strongly than the earth's, and so we can say its lunar capture is effectively underway. By 4 April, it will be in a tight orbit around the moon. A week later, on 11 April, Beresheet will actually attempt to land on the moon, an exercise that should take about 20 nerve-wracking minutes. Not least because it will be in free-fall for the final few metres. If it does successfully land, it will be the first privately funded spacecraft—and Israel just the fourth country—to achieve that feat.

Once on moon ground, Beresheet will seek to learn something about our neighbour's magnetic field. Moon rocks that the Apollo missions brought back were magnetized: how did that come about? An interesting puzzle, but really, everything about this effort is impressive. You could even say the length of the mission showcases exactly that. For as we follow the little

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spacecraft's convoluted path to the moon, we actually see all the required science and mathematics turn into reality: the orbits, the capture, all of it.

And that's probably why another of SpaceIL's co-founders, Kfir Damari, said this about their mission: "Our goal is to show (children) that (space flight is) not magic—it's something they can understand. If they can understand that, and if they can meet engineers and hear their story and see that they come from all different kinds of backgrounds, they can understand that they themselves can be those who will build the next spacecraft."

Beresheet won't be bringing back moon rocks—in fact, it won't be returning to earth at all. But what it stimulates here on earth might be even more valuable than rocks.

Trusted workhorse set to get new features

With the Indian Space Research Organisation (ISRO) planning to keep the fourth and final stage of the Polar Satellite Launch Vehicle (PSLV) 'alive' in space as a useful 'orbital platform', the rocket — popularly dubbed ISRO's trusted workhorse — is getting added features.

Set for lift-off this month with the Microsat-R payload, the upcoming PSLV-C44 mission will see a new variant of the PSLV in use. This variant, tagged PSLV-DL, will be the first to sport two strap-on boosters for providing added thrust.

Its final and fourth stage — PS4 — will be equipped with lithium-ion batteries, but no solar panels. An in-house technology, the lithium-ion cells are critical to keep the spent stage in orbit. Solar panels will be added, in all likelihood, in the next mission, Vikram Sarabhai Space Centre (VSSC) Director S. Somanath says.

ISRO had hit upon the idea of transforming the expendable fourth stage into a makeshift satellite to reduce space debris. In a normal scenario, the initial

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stages of the rocket, once they detach, drop back into the sea. However, stage four, after releasing the payload, wanders around in space as junk.

If the plan is successful, the spent stage will be automatically 'recycled' into a valuable platform for space-based experiments.

Mr. Somanath said ISRO would perfect the technology with tests spread over multiple missions. On the C44 mission, the ISRO will also test the downloading of data from the stage to the ground station. In subsequent missions, the space agency will carry out experiments using the platform.

ISRO cranks up Gaganyaan project

The Indian Space Research Organisation (ISRO) said work on 'Gaganyaan', the project to send a manned mission to space by 2022, would start soon at the newly created Human Space Flight Centre (HSFC).

"Gaganyaan is our highest priority now," K. Sivan, ISRO Chairman and Secretary, Department of Space, told reporters here. "We have put in a management structure to realise it. The Human Space Flight Centre [based in Bengaluru] will carry out all activities related to the human programme. Under it will function the Gaganyaan Project," he added.

Dr. Sivan also announced the appointment of Unnikrishnan Nair — who led ISRO's Advanced Space Transportation Programme at the Vikram Sarabhai Space Centre (VSSC) and has already worked in the area as the director of the Human Space Flight Project — as the director of the new centre.

The facility would be staffed by a dedicated team, with ISRO planning to deploy 800 to 900 people over time on the project.

ISRO's announcement of the new centre and the naming of its head comes about five months after the government first unveiled plans to send a manned mission to space.

R. Hutton, who helmed the PSLV light lift vehicle programme at the VSSC

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in Thiruvananthapuram, will be the project director in Dr. Nair's team and his deputy.

"All work related to the mission will formally begin now," Dr. Sivan said. This would include the schedule, blueprints for various tasks, astronaut selection with the Indian Air Force and systems based on the project report.

The ISRO chairman told The Hindu that the nodal Human Space Programme Office set up six months back under V.R. Lalithambika would continue to coordinate mission affairs at the space agency's headquarters.

While ISRO has projected a manpower requirement of 861 personnel for the project, including 761 to be appointed in addition to the routine annual hiring. It expects to recruit the team in stages.

ISRO's Indian Institute of Space Science and Technology, Thiruvananthapuram, which produces about 100 space engineers each year, would be a primary source of talent, said a senior official.

'Big bang'

"The year 2019 has started with a big bang with Gaganyaan getting the government's approval and budget for putting three astronauts in space for seven days," Dr. Sivan said. The astronauts will orbit Earth at a distance of 400 km.

"The HSPC will work full steam now," Dr. Sivan said. "We must select the astronauts, train them, create and ensure livable conditions in space for them bring them back safely and later rehabilitate them in their routines."

The heavy lift launch vehicle GSLV Mark III, which got operational in November after its second successive flight in a row, must be suitably certified or human-rated. It will have two non-crew flights in December 2020 and July 2021.

The actual flight with crew is targeted to happen by December 2021 — to meet the Prime Minister's goal of August 2022, India's 75th Independence anniversary.

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Study shows solar wind fills the night side of the Moon

A study using observations from Chandrayaan 1 mission has found how plasma particles from the solar wind make their way into the Moon's night side, filling up the wake region, long thought to be devoid of plasma particles. This has significance in understanding bodies like the Moon which do not have global magnetic fields.

In recent times, there has been a huge interest in understanding the plasma environment of the Moon, which is generated mainly by its interaction with the solar plasma wind flowing towards it from the Sun. This plasma wind consists of charged particles such as protons and is partly absorbed by the side of the Moon facing the sun. The rest of the solar plasma wind incident on the Moon flows around it, but leaves a wake (a void) on the side not facing the sun (the night-side of the Moon).

Recent studies

Earlier, it was believed that this wake was devoid of any particles. But recent Moon missions such as Chandrayaan-1, Kaguya, Chang'e-1 and Artemis have found evidence of refilling of near lunar wake (heights of 100 km to 200 km above the lunar surface on the night side) with solar wind protons.

Unlike the Earth, the Moon has no global magnetic field originating from a magnetized core. It has weak crustal fields that are too small to shield it globally from charged solar plasma particles incident on it. At some regions the crustal fields are quite strong and these are known as magnetic anomalies. The plasma particles scatter off these anomalous crustal fields.

The present work shows that solar wind protons scattered from the magnetic anomaly located at the South Pole Aitken basin on the Moon can enter the near wake region. "This is the first observational evidence for such a process," says Anil Bhardwaj of Physical Research Laboratory, Ahmedabad who is one of the principal investigators in this international collaboration. The work is

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published in Geophysical Research Letters.

The group also characterised the energy and flux of the proton population in the near wake region. They find that the flux, or intensity, of the protons is approximately 0.0005 times the solar wind proton flux. “Such a magnitude is comparable to the proton population in near wake due to other known processes and can significantly affect the electromagnetic environment in near wake region,” says Prof. Bhardwaj.

Chandrayaan 1 data

The data for the calculation was collected using the Chandrayaan-1 observations. “We used the observations from the Sub-keV Atom Reflecting Analyser (SARA) experiment on Chandrayaan-1,” says M. B. Dhanya, the first author of the paper.

Small scale crustal magnetic fields on the Moon can also cause scattering of impinging solar wind protons back into space. “This paper shows that such particles scattered from the lunar magnetic regions on the day side can get transported to the night side of the Moon, thereby contributing to plasma refilling in the near wake region,” says Dr Dhanya.

The interaction between the Moon and the solar plasma is a topic of interest now because understanding it can help us study any celestial body which has no atmosphere or global magnetic field, such as asteroids and some planetary satellites.

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Gaganyaan top priority: ISRO

The priorities for the Indian Space Research Organisation (ISRO) this year are working on the human space flight programmeGaganyaan and launching a major student outreach apart from the scheduled missions, said its Chairman Dr. K. Sivan, while stating that India is no less than China in its space programme.

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"A separate Human Space Flight Centre has been formed in ISRO. The Gaganyaan project will come under it and that's how we will target the first unmanned mission in December 2020," Dr. Sivan said.

Responding to questions on the Chinese space programme, he said China had gone slightly ahead following its human space programme but, "Once Gagayaan is launched, we will be equal to them in all respects."

Young scientist scheme

Stating that this year ISRO is planning to spread its wings in new areas, Dr. Sivan announced a Young Scientist Programme (YSP) and termed it their most important project to reach out to students.

Under the YSP, three students, 8th standard pass, would be selected from each of the 29 States and seven Union Territories and will spend one month at ISRO during which they will be given lectures, get access to research and development and will be given experience to build a satellite.

"If the satellite is good, we will launch it. This programme is similar to U.S. space agency NASA's student outreach," Dr. Sivan stated. This year ISRO has planned 32 missions, including 14 launch vehicles, 17 space craft and one demo.

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ISRO to launch military satellite tonight

Just before midnight, Indian Space Research Organisation's first mission of 2019 will put into space a 130-kg military imaging satellite, Microsat-R.

ISRO has shied away from sharing details of the spacecraft or its uses as it does routinely each time during its missions; except to say the satellite would be placed within 15 minutes after take-off in a polar orbit 274 km away from Earth.

This is much lower than any of its civil Earth observation spacecraft, which fly pole to pole over the globe at between 400 km and 700 km.

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According to information obtained from different sources Microsat-R and its payload come assembled from a handful of laboratories of the Defence Research and Development Organisation (DRDO) and is meant for military use. The satellite was "assembled outside and ISRO only interfaced it" with its own systems and the launch vehicle, just as it treats any customer satellite.

PSLV-C44 will be launched around 11.30 p.m. from the older First Launch Pad at the Satish Dhawan Space Centre, Sriharikota in Andhra Pradesh. For its part, ISRO is experimenting on two aspects of the vehicle. One is to reuse a waste stage.

"For us, the excitement is about reusing the spent fourth stage [PS4] of the rocket as an orbiting platform for future experiments," an official said. Kalamsat, a small student payload, will be the first to use PS4 as an orbital platform.

Amid the 28-hour countdown for the launch, ISRO Chairman K.Sivan said the PS4-Kalamsat experiment would be short-lived.

It would start about 1.5 hours from take-off and last about 14 hours until Friday midday. Later experiments with PS4 will be improved gradually, he said.

For the third time in ISRO's recent history, the mission team is slated to cut off and restart the PS4 engine twice over a flight lasting around 100 minutes.

ISRO's pre-launch brochure said, "In PSLV-C44, the fourth stage (PS4) of the vehicle will be moved to higher circular orbit so as to establish an orbital platform for carrying out experiments."

The other experiment with the launcher PSLV-C44 vehicle will be a new third variant having two strap-on boosters. Called the PSLV-DL, D standing for demonstration, it ranges between the older two variants.

ISRO tastes first success of 2019

Under a starry night and a waning gibbous moon, ISRO's PSLV C-44 broke

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the silence over a brimming Pulicat lake as it lifted off from Satish Dhawan Space Centre, SHAR, to successfully place into orbit a military satellite, Microsat-R.

The mission with the modified PSLV with just two strap-on motors, dubbed the PSLV-DL (dual strap-ons), marked another first for ISRO as it provided an alternative to its normal six strap-on motors. This will enable it to carry slightly higher payloads than its Core-Alone version.

Towards the end of the first stage, the rocket's plumes were white with its tail end burning bright red even as a large flock of birds passed on the horizon. A second later, as the rocket soared further into the night sky, the second stage ignition burned a bright orange propelling the rocket ahead.

In low orbit

Microsat-R, placed into orbit 13 and a half minutes after lift-off, is a defence application satellite. It is the first time an Indian satellite was being placed by ISRO in a low orbit at an altitude of 274 km. ISRO also used this launch as an opportunity to demonstrate the usability of the fourth stage of the rocket after the satellites are ejected into orbit.

Till Thursday night, the fourth stage used to just become yet another piece of space debris. However, ISRO has found a way to make use of this stage with a student satellite, Kalamsat, made by Space Kidz India, weighing just 1.26kg, attached to it.

"The first mission of 2019 is a grand success," ISRO Chairman K. Sivan said from Mission Control. "Another innovation is the making the fourth stage, as an experimental platform to do technology demonstrations and carry out science experiments by students," he said.

For experiments

This would enable any agency that wants to conducts experiments in space to use the fourth stage till it disintegrates naturally. The fourth stage of the

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rocket may be orbiting in space for six months to a year. ISRO is aiming to use this time-frame to enable agencies to run short time experiments. Mr. Sivan asked students in India to develop such satellites and ISRO would take care of the launch.

He also said ISRO was developing a Small Satellite Launch Vehicle (SSLV), smaller than the PSLV. The first SSLV launch will take place this year, he said.

CMB-Bharat project: listening to faintest murmurs of early universe

A three-week long programme entitled, 'Cosmology – The next decade', which consisted of a school to train early career researchers and a workshop for active researchers in the field of cosmology came to a close on 25 January. The workshop was held at ICTS-TIFR, Bengaluru. In the workshop, project CMB-Bharat, a project to listen to the faintest murmurs of the universe was mooted. CMB expands into Cosmic Microwave Background. The scientific space project CMB-Bharat has been presented as a proposal to ISRO and is being considered by it, said TarunSouradeep, from IUCAA, Pune. This was one highlight of the workshop which also saw discussions on the X-ray telescope eROSITA which is to be launched in June 2019.

"Schools of long duration, where there could be detailed courses, taught by the leaders in the field of cosmology are rare in our country. The last such effort was in 2008... Many of those students are now back as cosmology faculty in India and abroad," says Subhabrata Majumdar, who is with the Tata Institute of Fundamental Research, Mumbai (TIFR). "We hope this school will create the much-needed leaders for Indian cosmology in the coming decades," he added, in an email. The programme was organized by Subhabrata Majumdar, Rishi Khatri from TIFR, Mumbai and Aseem Paranjape from IUCAA, Pune.

TarunSouradeep, who is the lead proposer of CMB-Bharat, outlined the scope

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and plan of the project thus: "CMB-Bharat is a proposal for comprehensive next generation Cosmic Microwave Background (CMB) mission in international collaboration with major Indian contribution. It proposes 'near-ultimate' survey polarisation that would exhaust the primordial information in this 'gold-mine' for cosmology."

Scientific promise

The scientific promise of the project was threefold according to Dr Souradeep. The "ultrahigh-goal" according to him was that the project would reveal the first clear signature of quantum gravity and ultra-high-energy-physics in the very early universe. He clarified that this referred to quantum gravitational waves, which are different from what LIGO detectors had observed that were classical in nature. The "high" goals lay in neutrino physics where we could discover more about the neutrino species, their total mass and mass hierarchy; map all dark matter and most baryons in the observable universe, he said. The problem of knowing the hierarchy of masses of the different species of neutrino is a very deep one and being hotly pursued by many countries. The "legacy," he said, was to improve probe of cosmological model by a factor of over 10 million, and to generate rich galactic and extragalactic astrophysics datasets.

When asked about the timeline he had in mind for this project, he said that it was too early to make any definitive statements and that a more mature study had to be carried out. "Typically, ambitious space missions of this magnitude take over a decade [to] launch. We would like to be observing for 4-6 years and the time to final release of all data and release could extend to [about] 5 years," he said in an email to The Hindu.

Comprehensive mission

"There are no active proposals for a comprehensive next generation CMB space mission at this time. CMB-Bharat mission presents an unique

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opportunity for India to take the lead on prized quests in fundamental science in a field that has proved to be a spectacular success, while simultaneously gaining valuable expertise in cutting-edge technology for space capability through global cooperation," he added.

The workshop

The workshop was a unique gathering of cosmologists from across the world, and participants could attend invited talks by eminent cosmologists and experimental physicists from across the world, such as Lyman Page (2018 Breakthrough Prize, 2015 Gruber Prize), Rashid Sunyaev (2003 Gruber Prize, 2017 State Prize of Russia for Science and Technology), J. Richard 'Dick' Bond (2008 Gruber Prize, 2018 Gruber Prize as a team member, Officer in the Order of Canada) and others. This programmewas a decadal follow-up of a previous 6-weeks long ICTS programme "Cosmology with CMB and LSS" held in 2008.

GSAT-31 launched

India's 40th communications satellite GSAT-31 was successfully put into orbit by Ariane-5 rocket belonging to European launch services provider Arianespace early Wednesday, said Indian space agency ISRO and Arianespace.

According to ISRO, the telecommunications satellite, GSAT-31 was successfully launched on February 6, 2019 from Kourou launch base, French Guiana.

According to Arianespace, it opened its 2019 mission activity by successfully orbiting a pair of telecommunications spacecraft — Saudi Geostationary Satellite 1/Hellas Sat 4 (HS-4/SGS-1) and GSAT-31 with Ariane-5 rocket.

NASA's first mini-spacecraft in deep space go silent

NASA has lost touch with the first mini-spacecraft that ventured into deep space, according to the US space agency which said that it is unlikely the

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twin CubeSats will be heard from again.

The MarCO CubeSats were launched last year to test if such low-cost technology can operate in deep space. The twins, nicknamed EVE and WALL-E after characters from a Pixar film, served as communications relays during the InSight's Mars landing, beaming back data at each stage of its descent to the Martian surface in near-real time, along with InSight's first image.

WALL-E sent back stunning images of Mars as well, while EVE performed some simple radio science. Having travelled well past Mars, the twin CubeSats seem to have reached their limit, NASA said in a statement. It has been over a month since engineers have heard from MarCO, which followed NASA's Insight to the Red Planet.

At this time, the mission team considers it unlikely they will be heard from again. The experimental technology cost a fraction of what most space missions do — $18.5 million. WALL-E was last heard from on December 29 and EVE, on January 4. Based on trajectory calculations, WALL-E is currently more than 1.6 million kilometers past Mars; EVE is farther, almost 3.2 million kilometres past Mars.

The mission team has several theories for why they have not been able to contact the pair. WALL-E has a leaky thruster. Attitude-control issues could be causing them to wobble and lose the ability to send and receive commands. The brightness sensors that allow the CubeSats to stay pointed at the Sun and recharge their batteries could be another factor.

The MarCOs is in orbit around the Sun and will only get farther away as February wears on. The farther they are, the more precisely they need to point their antennas to communicate with Earth. The MarCOs will not start moving toward the Sun again until this summer. The team will reattempt to contact the CubeSats at that time, though whether their batteries and other

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parts will last that long cannot be predicted.

Even if they are never revived, the team considers MarCO a spectacular success. “This mission was always about pushing the limits of miniaturised technology and seeing just how far it could take us,” said Andy Klesh, the mission’s chief engineer at JPL.

“We’ve put a stake in the ground. Future CubeSats might go even farther,” Klesh said. A number of the critical spare parts for each MarCO will be used in other CubeSat missions. That includes their experimental radios, antennas and propulsion systems. Several of these systems were provided by commercial vendors, making it easier for other CubeSats to use them as well.

Gaganyaan’s review panel to meet in March

A national review committee on Gaganyaan is slated to meet for the first time here on March 5 and 6 and comprehensively scan the contours of the first Indian human mission to space.

The Indian Space Research Organisation (ISRO) wants to unveil the human mission’s details to stakeholders from multiple agencies, and also keep the nation in the loop about the prestigious mission, K.Sivan, ISRO Chairman and Secretary, Department of Space, said. He added, “It should also give us the confidence that we are on the right track with such a humongous project.”

The broad-based review committee may have around 100 experts and scientists related to all aspects of the Rs. 10,000-crore human mission, it is learnt.

The committee will also be briefed on March 6 on the lunar lander and rover mission, Chandrayaan-2, which may take place around April.

Back in November 2004, ISRO had first brainstormed a crewed mission at a similar gathering of nearly 100 experts in Bengaluru.

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Agreements and programmes planned with the Indian Air Force (IAF) and the Defence Research and Development Organisation (DRDO) will start taking shape from now on, Dr. Sivan told The Hindu. " Gaganyaan-related activities are in full swing," he said, under the newly formed Human Space Flight Centre (HSFC) and a dedicated team.

Gaganyaan was announced on August 15, 2018 as a marquee mission for the 75th year of Independence. It is slated to take place at a 'near-Earth' distance of 400 km.

Before that, two unmanned trial flights with human-friendly capsules are to be flown in 2020, carrying a few micro-gravity experiments.

Dr. Sivan said ISRO recently submitted to the IAF a set of requirements on selecting and training prospective Indian space travellers. The IAF would come back with details of its facilities. "In order to have three flight-ready finalists as crew, we need to give astronaut training to at least ten [eligible] persons," he said.

The astronauts will be mainly trained at the IAF's Institute of Aerospace Medicine in Bengaluru.

Stellar stream

A new study published in Astronomy & Astrophysics has shown a stream of at least 4,000 stars moving together in space. Astronomers have planned to study them to understand more about Milky Way's gravitational field.

Solar tsunami can trigger the sunspot cycle

It is believed that the "solar dynamo" — a naturally occurring generator which produces electric and magnetic fields in the sun — is linked to the production of sunspots. What kick-starts the 11-year sunspot cycle is not known. Now, a group of solar physicists suggests that a "solar tsunami" is at work that

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triggers the new sunspot cycle, after the old one ends.

The extreme temperature and pressure conditions that prevail some 20,000 km below the sun's surface cause its material to form a plasma consisting primarily of hydrogen and helium in a highly ionised state. The plasma is confined with huge magnetic fields inside the sun. Explains Dr. Dipankar Banerjee from the Indian Institute of Astrophysics, Bengaluru, and one of the authors of the paper published in Scientific Reports , "The [sun's] toroidal magnetic field, from which sunspots get generated, wraps around the sun in the east-west direction."

Celestial rubber bands

These magnetic fields behave like rubber bands on a polished sphere. They tend to slip towards the poles. Holding these fields in their place requires that there is extra mass (plasma mass) pushing at the bands from higher latitudes. Thus, a magnetic dam is formed which is storing a big mass of plasma. At the end of a solar cycle, this magnetic dam can break, releasing huge amounts of plasma cascading like a tsunami towards the poles.

These tsunami waves travel at high speeds of about 1,000 km per hour carrying excess plasma to the mid-latitudes. There they give rise to magnetic flux eruptions. These are seen as the bright patches that signal the start of the next cycle of sunspots. The tsunami waves can traverse the required distance in a few weeks, unlike in earlier models.

Humongous calculation

To arrive at this simulation, the group used data from the Kodaikanal observatory of sunspots recorded over 100 years and the Cheyenne supercomputer belonging to National Center for Atmospheric Research (NCAR), Boulder, U.S. MausumiDikpati of NCAR and first author of the paper said in an email to The Hindu , "Cheyenne has 1,45,000 processors, and is a 4.5 petaflop machine. Each of these processors can perform 184 million arithmetic operations per

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second," says MausumiDikpati of NCAR, the first author of the paper."

She adds "We used about 100,000 processor cores of the supercomputer to perform about 100 simulations to conclude our results. This means in each of these hundred simulations, we performed about 66,000 trillion arithmetic operations per hour."

Adds Dr. Banerjee, "The solar cycle and sunspot activity are intimately connected with space weather. The model provides a sound physical mechanism supporting why we should expect the next sunspot cycle 25 to begin in the year 2020, followed by a strong increase in space weather shortly after the trigger of a series of new sunspots in that year."

Debris from anti-satellite test to disintegrate in 45 days: official

The satellite targeted with an Anti-Satellite (ASAT) missile under Mission Shakti has broken up into at least 270 pieces, most of which are expected to disintegrate within 45 days, Defence sources said .

"The satellite has disintegrated into at least 270 pieces which has also been confirmed by the North American Aerospace Defence Command (NORAD). One of them is a large piece that has been deorbited and is estimated to be completely degraded by April 5," the official said. The rest of the pieces are estimated to disintegrate in less than 45 days, he stated.

Being in the Low Earth Orbit, the debris would fall towards earth and burn up as soon as they enter the atmosphere.

Imaging satellite

Officials identified the targeted satellite as Microsat-R, an imaging satellite that was launched by the Indian Space Research Organisation (ISRO) on January 24 using a Polar Satellite Launch Vehicle. The satellite, weighing 740 kg, was placed in an orbit of 274 km above earth.

The Defence Research and Development Organisation (DRDO) shot down

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Microsat-R with a modified exo-atmospheric missile of the ballistic missile defence at an altitude of 300 km.

Being monitored

The ASAT test was tracked by sensors of various agencies. Upon impact, data transmission from the satellite stopped and electro-optic systems confirmed an explosion, the official said.

Other ISRO satellites and systems too noticed the breakup of Microsat-R, another official said, adding that the debris was being monitored.

Separately, U.S. officials in Washington have confirmed the test and the debris generated. Lt. Gen. David Thompson, vice-commander of the U.S. Air Force Space Command, said in a hearing before a subcommittee of the U.S. Senate Armed Services Committee that soon after the test, their agencies began collecting information about the break-up of the vehicle and are "tracking about 270 different objects in the debris field."

"Likely, that number is going to grow as the debris field spreads out and we collect more sensor information," he informed the committee and added that the debris posed no immediate threat to the International Space Station or most other satellites in Low Earth Orbit.

'ASAT shows conversion of capability to technology'

The Anti-Satellite (ASAT) missile test conducted demonstrates that we can protect our space assets as part of the all-round space capability, said Dr. AvinashChander, former Chief of the Defence Research and Development Organisation (DRDO).

"We have been working on ASAT capabilities for some time... Once we had long range missiles, and once we had the kill vehicles for our Anti-Ballistic Missile (ABM) defence, we had worked out in our mind that we had ASAT capability. Wednesday's demonstration was converting that capability into a technology and a product which is a major step forward. That has been

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achieved," Dr. Chander told The Hindu .

He was the architect of the Agni missile programme and the strategic weapons capability made major strides during his tenure. However, he said that no formal ASAT programme had been taken up earlier.

Dr. Chander said that existing booster and kill vehicle of the BMD programme has been adapted for the ASAT missile. The missile tested hit a satellite at 300 km, Dr. Chander said India has "intentionally taken a low earth satellite where the debris does not last for more than a few months."

He said it doesn't matter if the target satellite is 250 km or 800 away. "We can now reach any orbit, low earth and mid-earth..."

Anti-sat weapons date back to Cold War

Anti-satellite weapon systems have a long history and were a product of the Cold War hostilities between the United States and the Soviet Union. However never have countries claimed credit for shooting down their satellites to test their ATS. India has made a departure.

What are anti-satellite (ASAT) weapons?

They are missile-based systems to attack moving satellites. So far the United States, China and Russia were the only ones who've reported the ability to shoot down space objects from ground or airborne sources.

Anti-satellite weapons came back into popular currency after China conducted an anti-satellite missile test on January 11, 2007. The target was a Chinese weather satellite — the FY-1C – that sailed at an altitude of 865 km. (537 mi). A year later, the United States launched 'Operation Burnt Frost,' the code name to intercept and destroy a non-functioning U.S. National Reconnaissance Office (NRO) satellite named USA-193.

What are India's capabilities so far?

India's ASAT development has a long history with Dr. V.K. Saraswat, Director-

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General of the Defence Research and Development Organisation stating in 2012 that India had "all the building blocks necessary" to integrate an anti-satellite weapon to neutralise hostile satellites in low earth and polar orbits. However there was never any formal announcement of such a mission.

What's new about India's ASAT system?

While Mission Shakti may have targeted an object in outer space, India has long developed the ability to intercept incoming missiles. In 2011, a modified Prithvi missile, mimicked the trajectory of a ballistic missile with a 600-km range. Radars at different locations swung into action, tracking the "enemy" missile, constructing its trajectory and passing on the information in real time to the Mission Control Centre (MCC) to launch the interceptor, an Advanced Air Defence (AAD) missile. It had a directional warhead to go close to the adversarial missile before exploding to inflict damage on it.

What are low earth orbit satellites?

The Indian satellite that was shot down was a Low Earth Orbit (LEO) satellite. These are satellites roughly at an altitude of 2,000 kilometres from the earth and that's the region where the majority of satellites are concentrated. A database from the Union of Concerned Scientists, a non government organisation based in the United States, says that there are at least 5 known Indian satellites in LEO: India PiSat, Resourcesat 2, Radar Imaging Satellites 1and2 and SRMsat.

Atomic Energy

Government of India

AERB

Atomic Energy Regulatory Board

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Wind energy capacity expansion to slow in next five years: Crisil

Capacity addition in the wind energy sector will slow down over fiscal 2019 to 2023, with only 14-16 GW being added due to a decline in bid responses and profitability of original equipment manufacturers, according to a report by Crisil.

"Crisil Research expects capacity addition to grow slowly over the next five years, driven by the allotment of central transmission utility's (CTU) grid connected capacities," Crisil said in the report.

"The shift to a competitive bidding mechanism has slowed industry growth due to a significant fall in tariffs, triggering a decline in both bid response and profitability for original equipment manufacturers (OEMs)."

The shift to a competitive bidding mechanism in the wind energy sector has resulted in tariffs falling to Rs. 2.4-2.6 per unit, from Rs. 4-4.5 per unit under the feed-in tariff regime.

According to Crisil, such low realisations are unviable for the entire value chain at current capital costs of Rs. 6.8-7.2 crore per MW.

"Crisil Research expects capacity addition of 14-16 GW over fiscal 2019 to 2023, entailing investments of about Rs. 1,10,000 crore," Crisil said in the report.

"Capacity additions will primarily be driven by central government allocations with relatively stronger counterparties such as Solar Energy Corporation of India (SECI) and PTC India, reducing risk compared with direct exposure to state discoms."

State auctioning; on the other hand, has slowed as several States have signed power supply agreements (PSAs) with PTC and SECI to procure wind power under the schemes auctioned by them, to help fulfill their non-solar renewable purchase obligations (RPO) targets, according to Crisil Research.

Large hydro projects get 'renewable energy' status

The Union Cabinet approved a new hydroelectric policy aimed at boosting

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the sector; including according large hydro projects the status of renewable energy projects.

According to the new policy, large hydro projects will also be designated as renewable energy projects. So far, only smaller projects of less than 25 MW in capacity were categorised as renewable energy.

With the removal of this distinction, large hydro projects will be included as a separate category under the non-solar renewable purchase obligation policy. Under this policy, power purchasers will have to source a portion of electricity from large hydro projects.

"The hydro policy was in the works for a long time," Power and Renewable Energy Minister R.K. Singh said.

He also said the new policy had increased the debt repayment period for hydro projects to 18 years from the current 12 years with the provision to introduce an escalating tariff of 2%.

Silver atoms of nanoparticles are mobile, IIT Madras team finds

While atoms in silver metal remain in their positions forever in bulk material, their behaviour changes completely at the nanoscale, researchers at Indian Institute of Technology (IIT) Madras have discovered.

When nanoparticles made of two silver isotopes (107Ag and 109Ag) having just 25 atoms each were mixed in solution, a team led by Prof. T. Pradeep of the Chemistry Department found that the atoms from the two particles rapidly exchanged their positions. New particles composed of nearly 50% mixture of both isotopes were formed. This is akin to the exchange of hydrogen and deuterium atoms when normal and heavy water (D2O) are mixed. Even in an alloy of silver and gold, a rapid exchange of silver atoms was seen.

"This is a surprising find for the nanoscience community. We have always been thinking that silver and gold particles are rigid, well defined structures even at the nanoscale. But we observed silver atoms undergoing dynamic changes

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in solution," says Prof. Pradeep. "Unlike bulk silver, silver nanoparticles are not rigid and fixed at specific locations as we thought them to be." The results were published in the journal Science Advances.

The rapid exchange of silver atoms in solution might have implications in real-life situations. "The properties of nanoparticles such as catalysis, drug delivery, and biological sensing may all be viewed differently in view of this rapid atom exchange," Prof. Pradeep says. "In homogeneous catalysis involving nanoparticles, the site at which chemistry occurs could be changing continuously," the authors write.

The silver particles composed of 25 atoms were protected by ligands to form clusters. Despite the protection offered by the ligand, the atom exchange between the two clusters happened in millisecond time-scale. The new cluster, which was formed by mixing of atoms belonging to two isotopes, had almost 50:50 ratio of the isotopes.

The researchers found that the rate at which the atoms exchanged could be controlled by changing the temperature. While the exchange was rapid at room temperature, at –20 degree C, the exchange rate was slower and took about 30 seconds to attain equilibrium distribution. The relatively longer time taken to reach equilibrium allowed the researchers to observe the in-between states of atom exchange. They found that the atom transfer rate is similar to that in water.

Slower exchange rate

The atom exchange rate slowed down drastically when silver nanoclusters were composed of 29 atoms — it took about three hours to reach dynamic equilibrium at room temperature compared with rapid exchange in the case of 25-atom clusters. The slower exchange rates allowed the researchers to study the dynamics in greater detail.

The exchange went through multiple steps. First, there was rapid exchange of atoms at the surface of the nanoparticle. Then the exchanged atoms diffused

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into the core of the nanoparticle making more exchange at the surface possible. Finally, there was equilibration of the mixed isotope system.

"The difference in the exchange rate between the clusters made of 25 and 29 silver atoms is not due to the difference in the number of atoms but due to the ligand used for binding to the silver atoms," says Papri Chakraborty from the Department of Chemistry at IIT Madras and first author of the paper. "The ligand binds to each silver atom at just one site in the case of the cluster composed of 25 atoms. But it binds at two sites of the silver atoms in the 29-atom cluster thus rendering the structure rigid."

"Such dynamics can occur in any nanosystem. Fundamental insight the study provides is that nanoparticles are indeed molecules," Prof. Pradeep says.

ISRO lists 10 firms to make li-ion cells

The Indian Space Research Organisation (ISRO) named 10 companies to which it proposes to transfer the technology for manufacturing Lithium-ion cells developed by the Vikram Sarabhai Space Centre (VSSC), Thumba.

Originally developed for use in launch vehicles and satellites, this ISRO spin-off will now fuel India's electric vehicle boom.

Majority of the companies selected for the commercial production of the li-ion battery are private-owned, with one from Kerala — Carborundum Universal Ltd based in Kochi.

The shortlisted companies are the following: Amara Raja Batteries Ltd, Chittoor, Andhra Pradesh; Bharat Electronics Ltd, Pune; Carborundum Universal Ltd, Kochi; Exicom Tele-Systems Ltd, Gurgaon; GOCL Corporation Ltd, Hyderabad; Jyoti CNC Automation Ltd, Rajkot; National Aluminium Company Ltd (NALCO), Bhubaneswar; Sukhbir Agro Energy Ltd, New Delhi; Tata Chemicals Ltd, Mumbai, and Thermax Ltd, Pune.

The ISRO and VSSC selected the companies jointly with the NITI-Aayog from a long-list of 141 firms. According to VSSC officials, the space agency will help the companies set up the Lithium-ion cell manufacturing units and provide

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training for their staff.

For its own use, the VSSC had developed li-ion cells with capacities ranging from 1.5 Ah to 100 Ah.

Subsequent search for an industry partner for commercial production of the battery had hit a wall until the Union government stepped in.

NIIST's photo luminescent ink shows good photo stability

Using a novel approach, researchers at the National Institute for Interdisciplinary Science and Technology (CSIR-NIIST), Thiruvananthapuram have formulated a fast-drying fluorescent ink that retains over 70% photoluminescence intensity even at the end of one month. There was 26% drop in emission intensity within one hour of printing using the ink containing the fluorescent dye and further drop of 2% in two hours. But no reduction in emission intensity was seen after three hours.

This has become possible with the team led by Dr. K.P. Surendran from the Materials Science and Technology Division at NIIST encapsulating the fluorescent dye — fluorescein — within double-layered silica nanospheres. Since encasing the dye using a single layer of silica did not completely prevent dye leakage, the researchers used a second layer for encapsulation. The silica nanospheres are 70-80 nanometres in size.

As a result of the double-layered encapsulation, fluorescent dye is largely protected from dispersants, solvents and binders present in the ink. So there is less likelihood of reduction in photoluminescence intensity through dye leakage. Encapsulation of the dye in double-layered silica nanoparticles also prevents cluster formation. The dye used without any encapsulation lacks photo stability and the fluorescence completely decays within a couple of hours. The results were published in the journal ACS Omega.

Fluorescent ink is used for a wide range of applications in domains such as

anti-counterfeiting, information storage, bio-imaging, smart packaging, and Nano-electronics. Retention of photoluminescence for prolonged periods is a major challenge in fluorescent inks.

"Since the fluorescent dye should not come in contact with the solvent present in the ink as this would cause decay in photoluminescence, we encapsulated it in double-layered silica nanoparticles," says Kanakangi S. Nair from NIIST and first author of the paper. "The fluorescent double-layered silica nanoparticles assemblies were synthesised through a reverse micro-emulsion technique."

When dye encapsulated in double-layered nanoparticles was dispersed in the solvent, it shows strong fluorescence. But when the encapsulated dye was formulated into ink, the emission intensity reduced by 10%. "The fluorescence gets slightly reduced but is not significantly affected by other components present in the ink," says Dr. Surendran.

Quick drying

Another advantage that the team observed is the quick drying of the ink at room temperature. "It dried in less than 20 seconds at room temperature. The formulation of the ink was meticulously designed so as to allow quick drying without using any external drying agents," Dr. Surendran notes. However, most commercial fluorescent inks are cured using ultraviolet lamps or infrared emitters, or a combination of both.

The dried ink containing the dye is cream in colour under visible light but turns green when exposed to ultraviolet light. When the UV light is cut, the dye immediately regains its original colour (cream).

The team used commercially available dye and is now working to encapsulate NIIST propriety dyes using the same procedure. The propriety dyes have multiple emissions and so will help in increasing the security feature of the ink.

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Belle II: Chasing cousinly rivalry at the subatomic level

Belle II, a particle accelerator experiment located in Tsukuba, Japan, is a unique facility in the world. Here, electrons and positrons (anti-electrons) collide to produce B mesons in order to study the breakdown of symmetry in these decays. As an international collaboration involving 26 countries, Belle II has an Indian link -- a team led by physicists and engineers from the Tata Institute of Fundamental Research, Mumbai, have built the fourth layer of the vertex detector.

The focus at Belle II is on B-mesons — particles that contain the B-quark, also known as the beauty or bottom quark. Says Tom Browder from the University of Hawaii who is also the spokesperson for Belle II, “In particular, we focus on the differences between the decay of the B-mesons and that of their antiparticles, the anti B-mesons. We are looking for the breakdown in the symmetry between matter and antimatter.”

This broken symmetry between matter and antimatter is one of the most fundamental questions in particle physics.

Asymmetric universe

At the time of the Big Bang some 13.7 billion years ago, the universe was in a fully symmetric state with equal quantities of matter and antimatter. Yet, today, we are in this extremely antisymmetric state. The question is how did we get here? One of the first theoretical ideas about this was posed by Andrei Sakharov. Says Dr. Browder, “As soon as the first differences were discovered in particle physics between kaons and antikaons in 1964 at Brookhaven, Sakharov realised this was an important clue to understanding this asymmetry between matter and antimatter.” Sakharov suggested that we start with this symmetric state of the universe at the beginning, then decays of elementary particles that were asymmetric between particles and antiparticles amplified this difference. That led to the matter-dominated universe.

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The original CP violation, or asymmetry between matter and antimatter, which was discovered in 1964, was found in Kaons — particles containing the strange quark. The effects there were tiny — about one part in a thousand.

Dr. Browder explains, "For the particles containing the B quark, the effects of this matter-antimatter symmetry are large; they are of order 100%. The B quarks have much greater asymmetry. They are theoretically much easier to understand they are cleaner. That's also the motivation for these machines."

In addition to other experiments at CERN, the European Organisation for Nuclear Research, there's one experiment that is devoted to B quark physics — the LHCb or the Large Hadron Collider beauty experiment. In this, two proton beams are collided at high energies and the results are observed.

Says Dr. Browder, "The facility in Japan uses electron-positron collisions. These are much cleaner, as the electron and positron are point-like particles. So, we will be in a competition with the LHCb as time proceeds." He adds laughingly, "At the LHCb, they throw two Swiss watches at each other and [a] lot of stuff comes out, while we have clean collisions of point-like particles."

Anomalous interactions

In the Standard Model – the core theory of particle physics – there are generations of low mass particles (leptons); electrons, the muon and the relatively heavy cousin of the electron, the tau are the leptons. These particles are expected to have identical interaction strengths, the so-called couplings, in the Standard Model of weak interactions in physics. However, in particle decays where only leptons are produced (leptonic decays), it appears that the tau and muon particles have identical couplings. Specifically, interactions where a kaon particle decays to muon and a kaon decays to electron seem to have the same coupling to 1%. But B decays to tau leptons when compared to B decays to muon or electron are not on equal footing.

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"There is a hint of an anomaly there at 4 standard deviation," says Dr. Browder, excitedly. However, he adds a word of caution: "We'd like to get much more data to see whether this is a fluctuation or whether we can pin this down and declare we have found new physics!"

There is a similar thing in the B quark to S quark decay: The so-called Penguin decays. "If any one of this can be established, it would be fairly new physics," he adds, mentioning that the Chennai group led by Rahul Sinha of The Institute of Mathematical Sciences works on the angular correlation in these decays.

Ooty's muon detection facility measures potential of thundercloud

For the first time in the world, researchers at the GRAPES-3 muon telescope facility in Ooty have measured the electrical potential, size and height of a thundercloud that passed overhead on December 1, 2014. At 1.3 gigavolts (GV), this cloud had 10 times higher potential than the previous record in a cloud. This is not because clouds with such high potentials are a rarity, but rather, because the methods of detection have not been successful so far.

Cloud structure

Clouds have negative charges along their lower side and positive charges on top and can be several kilometres thick. If balloons are used to measure the potential difference between the top and bottom, they will take hours to traverse the distance. Unfortunately, thunderstorms last only for about 15-20 minutes, and this method fails.

The Ooty group did not really set out to measure the cloud's potential. Sunil Gupta from TIFR, Mumbai and corresponding author of the paper published in Physical Review Letters, says that he was first intrigued by the way the muon intensity dipped briefly in a manner correlated with the thunderstorm. Though it was known that thunderstorms had an effect on muon intensity, it had not been probed in detail earlier. Dr Gupta urged the researchers in his

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team to study this carefully.

Threshold of detection

Muons and other particles are produced when cosmic rays bombard air particles surrounding the earth. The muons produced can have positive or negative charge. When a positively charged muon falls through a cloud, it loses energy. If its energy falls below 1 giga electron volt (GeV), which is the threshold of detection of the GRAPES-3 muon telescope, it goes undetected. On the contrary, a negatively charged muon gains energy when falling through the cloud and gets detected. Since there are more positive than negative muons produced in nature, the two effects don't cancel out, and a net change in intensity is detected.

From April 2011 to December 2014, the group studied the variation of muon intensity during 184 thunderstorms. In seven events they came across thunderclouds that corresponded to a large change in muon intensity, of above 0.4%. They also simultaneously monitored the profiles of the clouds using four ground-based electric field monitors. Only the cloud that crossed on December 1, 2014, had a profile that was simple enough to simulate.

Using a computer simulation and the observed muon intensity variations, the group worked out the relationship with the electric potential of the cloud. They calculated that the potential of the cloud they were studying was approximately 1.3 GV. "To best of our knowledge no one has ever measured potential, size and height of a thundercloud simultaneously. That is the reason for all the excitement," says Dr Gupta.

Clue to puzzle

Dr Gupta and his colleagues surmise that this method can be used to solve a 25-year-old puzzle of terrestrial gamma ray bursts — huge flashes of light that accompany lightnings, but which have not been explained in theory until now.

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Learning about the properties of thunderclouds can be useful in navigation of aircraft and preventing short circuits. This serendipitous discovery might provide the means to making headway in this direction.

Climate change may hit India's wind power

Increased warming in the Indian Ocean and the resultant weakening of the Indian summer monsoon may come in the way of India's goal of leading the world's wind power generation.

Analysing the available wind and atmospheric data from 1980-2016, researchers from Harvard University, U.S., and National Climate Center in Beijing, China, found the potential electricity production of windmills across India had decreased by about 13%. And this trend might continue.

However, researchers in India have raised doubts about the results of the study. "The data used by the team does not correlate with the live data we have. We have started additional studies to validate these results and will publish the findings soon," says Dr. K. Balaraman, Director General, National Institute of Wind Energy, Chennai, under the Government's Ministry of New and Renewable Energy.

In the paper published last December in Science Advances, the researchers showed a decline in electricity production in the States of Rajasthan, Maharashtra, Gujarat, and Karnataka. No significant decline was seen in Tamil Nadu, which is located on the east coast and, thus, had different wind conditions during summer.

Long-term goals

"The government could concentrate on setting up more projects in this region [Tamil Nadu] as the lifetime of wind turbines is 20 to 30 years. We need to look at long-term goals," says Meng Gao, a postdoctoral fellow at the School of Engineering and Applied Sciences, Harvard University and the first author

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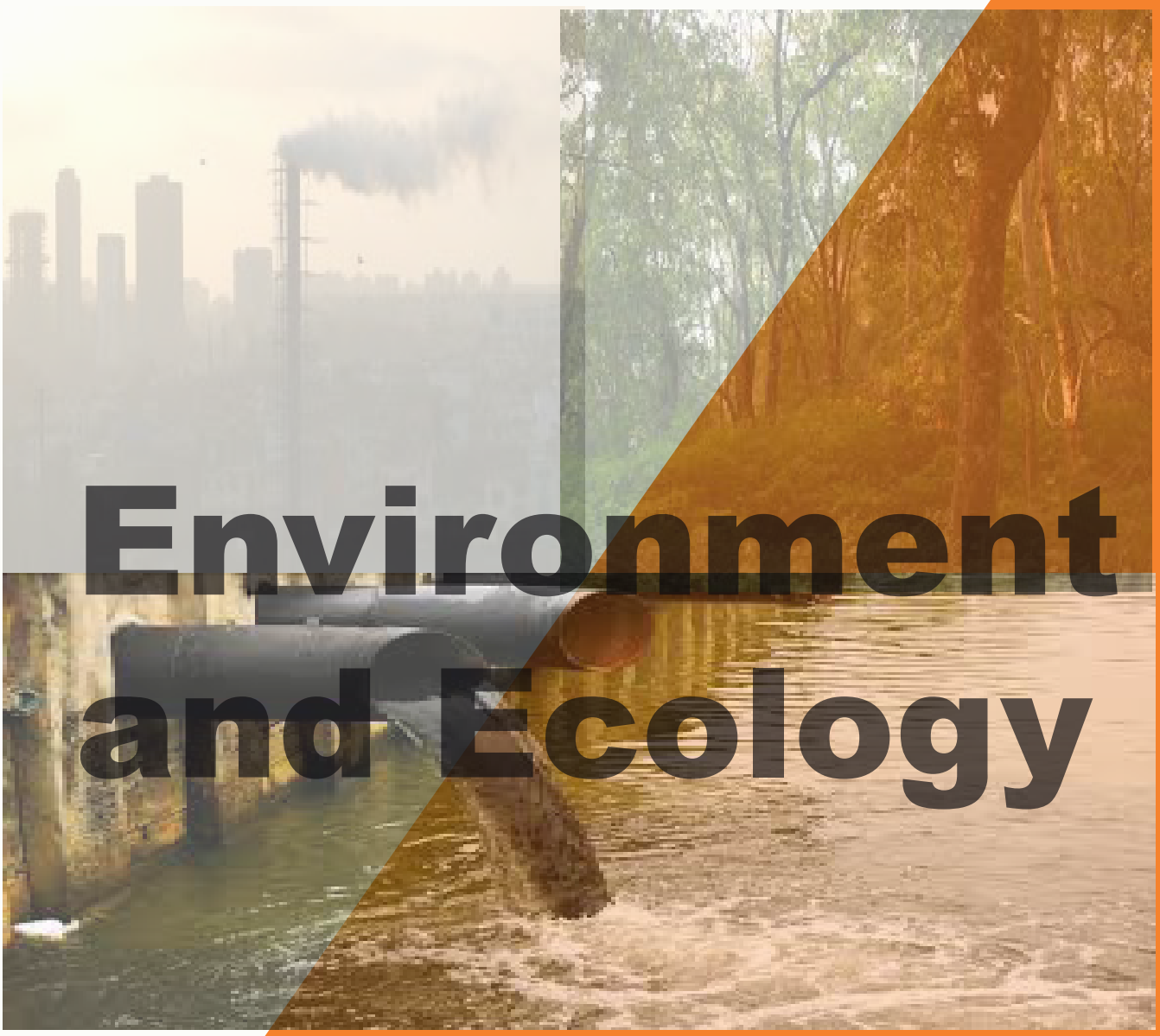
of the study. The researchers showed that 63% of the annual production of electricity from wind is contributed by winds in spring (March-May) and summer (June-August). Interestingly, they found a decrease in wind power during these months. This could be due to the weakening of the Indian summer monsoon during this period.

Summer winds

Summer winds in India are driven by the temperature contrast between the Indian subcontinent and the Indian Ocean, and the warming in the Indian Ocean reduced this contrast. Also, warming of the Equatorial Indian Ocean resulted in a decline in the wind speed.

The Indian government has set a target of 60 GW of cumulative wind power capacity by 2022. The researchers say that this goal can be beneficial only if planners in India take these historical reconstructions into account while setting up wind power installations in the future. “Our findings can provide suggestions on where to build more wind turbines to minimise the influences of climate change,” said Prof. Michael B. McElroy, from the School of Engineering and Applied Sciences, Harvard University and senior author of the study in a release.



Environment and Ecology

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India to tie-up with 4 nations to save rhinos

India will collaborate with Bhutan, Nepal, Indonesia and Malaysia to increase the population of three species of Asian rhinos, including the Greater one-horned rhinoceros found in the Indian sub-continent. The five rhino range nations signed a declaration 'The New Delhi Declaration on Asian Rhinos 2019' for the conservation and protection of the species at the recently held Second Asian Rhino Range Countries meeting here.

During the meet, Union Environment Minister Harsh Vardhan affirmed India's commitment towards rhino conservation.

The declaration was signed to conserve and review the population of the Greater one-horned, Javan and Sumatran rhinos every four years to reassess the need for joint actions to secure their future.

"The national strategy will pave the path for long-term conservation of the Greater one-horned rhinos in India," Mr. Vardhan said.

The declaration includes undertaking studies on health issues of the rhinos, their potential diseases and taking necessary steps; collaborating and strengthening wildlife forensics and strengthening of transboundary collaboration among India, Nepal and Bhutan for conservation of the Greater one-horned rhino.

Fifteen of the 20 most polluted cities in the world are in India

Fifteen of the top 20 most polluted cities in the world are located in India, according to an analysis of air quality in several cities around the world.

Gurugram, in Haryana, topped the list with an average annual particulate matter (PM 2.5) quality of 135 micrograms/cubic metre, in 2018. Delhi — a frequent fixture on global pollution hotspots — was only the 11th most noxious city behind Lahore, Pakistan (10th) and Hotan, China (8th). The other cities in India that made the list of 20 were Ghaziabad, Faridabad, Bhiwadi, Noida, Patna, Lucknow, Jodhpur, Muzaffarpur, Varanasi, Moradabad, Agra, Gaya

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and Jind.

When ranked by country, Bangladesh emerged as the most polluted followed by Pakistan and India respectively.

Of the cities analysed, 64% exceeded the WHO's annual exposure guideline (10 micrograms/cubic metre) for fine particulate matter, also known as PM2.5. India's annual guidelines range from 40-60 g/m3, depending on whether they are residential or industrial areas.

Every single one of measured cities with data in the Middle East and Africa exceeded the WHO guideline, while 99% of cities in South Asia, 95% of cities in Southeast Asia and 89% of cities in East Asia breached this level.

The ranking — a one of its kind study that relies on ground-based sensors located in 3,000 cities from 73 countries — was compiled by IQAir Group, a manufacturer of air-monitoring sensors as well as purifiers and environmentalist group Greenpeace.

Pollution hubs

Jakarta and Hanoi emerged as Southeast Asia's two most polluted cities and average concentrations in the cities in China fell by 12% from 2017 to 2018. Beijing ranks now as the 122nd most polluted city in the world in 2018 and China, the 12th most polluted country in the world. Of the countries analysed, Iceland emerged as the one with the cleanest air.

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Ministry plugs loophole that allowed plastic waste import

The government has plugged a loophole that allowed the import of plastic waste into India for processing.

"…Solid plastic waste has been prohibited from import into the country including in Special Economic Zones (SEZ) and by Export Oriented Units (EOU)," the Ministry of Environment, Forest and Climate Change (MoEFCC) Environment Ministry said in an order made public . The change in law was part of the Hazardous and Other Wastes (Management & Transboundary

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Movement) Amendment Rules, 2019.

The Hindu had reported on January 21 that India, in spite of having a significant plastic pollution load of its own, and a ban on plastic waste imports, imported PET bottles from abroad for processing in Special Economic Zones (SEZ).

The influx of PET bottles has quadrupled from 2017 to 2018, the Delhi-based environmentalist organisation, Pandit Deendayal Upadhyay Smriti Manch (PDUSM) had pointed out in January.

"Indian firms are importing plastic scrap from China, Italy, Japan and Malawi for recycling and the imports of PET bottle scrap & flakes has increased from 12,000 tonnes in FY 16-17 to 48,000 tonnes in FY 17-18 growing @ 290%. India has already imported 25,000 MT in the first 3 months of FY 18-19," a note by the organisation revealed.

India consumes about 13 million tonnes of plastic and recycles only about 4 million tonnes. To incentivise domestic plastic recycling units, the government had banned the import of plastic waste, particularly PET bottles, in 2015. In 2016, an amendment allowed such imports as long as they were carried out by agencies situated in SEZs.

A senior MoEFCC official had told The Hindu that while the Ministry couldn't vouch for whether such plastic imports had quadrupled, it was true that the imports had "substantially increased" and action was being contemplated.

Lack of an efficient waste collection and segregation system is the root cause for much of the plastic not making to recycling centres.

Supreme Court warns Haryana on damage to Aravalli range

The Supreme Court cautioned the Haryana government against doing "anything" to harm the ecologically fragile Aravalli range.

A Bench, led by Justice Arun Mishra, was responding to a submission by Solicitor General Tushar Mehta that he would prove that the State has not introduced amendments in the Punjab Land Preservation Act (PLPA), 1900,

in order to give a leeway to illegal mining or builders.

Liable for contempt

"We are concerned with Aravalli. If you are doing anything with Aravalli or Kant Enclave (where the top court had ordered demolition of buildings due to illegal constructions in forest area) you will be in trouble. If you are doing anything with forest, you will be in trouble. We are telling you," the bench told Mr. Mehta.

On March 1, the court had threatened the Haryana government with contempt if it went ahead with the amendments virtually allowing massive scale of construction in the Aravalli Hills.

The court had said the amendments pull the carpet from under a series orders passed by the Supreme Court over the years to protect the Aravalli and Shivalik ranges from builders and indiscriminate mining.

The court had pointed out how the once-lush Aravalli region was devastated after years of indiscriminate and illegal mining. "The entire Aravalli area is devastated and entire flora and fauna there has gone," the court had said in a hearing on February 4.

In October last, the court had expressed shock over 31 "vanished" hills in the Aravallis and had asked Rajasthan to stop illegal mining in 115.34-hectare area.

New KIA terminal will have 'forest' with local trees

The city's green cover may be under threat, but passengers flying through Kempegowda International Airport may one day get a chance to enjoy a 'forest' filled with local trees at the upcoming terminal 2.

A 2,55,645 square metre area has been designated for it in the Rs. 3,500 crore terminal, the first phase of which is expected to operational by 2021.

At a media briefing, Hari Marar, managing director and CEO of BIAL, said

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the 'forest' will have specimens of native trees, flowering and scented plants and water bodies. However, there will be no fruit trees for fear that they will attract birds.

The BIAL has taken up infrastructure projects worth Rs. 13,000 crore, of which Rs. 3,500 crore will be invested for building the terminal in two phases. The work on the first phase has already begun and is expected to be operational in a little over two years.

The BIAL is investing Rs. 2,700 crore in the form of equity and rest will be raised as debt. Road widening, improving cargo facilities and water recycling are some of the projects that have started.

Mr. Marar added that the KIA will be in a position to give employment to 45,000 people by 2025. Currently, 20,000 people are working at the airport.

Chilika Lake possesses 20% of India's seagrass

Chilika Lake is claimed to have 20% of India's seagrass distribution, which plays a vital role in oxygen production and absorption of carbon dioxide and acts as a purifier in aquatic ecology.

According to the Chilika Development Authority, the apex body for the Lake's management, seagrass species such as Holoduleuninervis, Holodulepinifolia, Halophila ovalis, Halophila ovata and Halophila beccarii were recorded during annual monitoring of the Chilika Lake held.

"Seagrass distribution has been estimated over an area of 152 sq. km, an increase from 135 sq km in the last year. Increase in seagrass has been reported against its declining trend throughout the world and now Chilika has 20% of India's seagrass," said CDA Chief Executive Susanta Nanda.

"Seagrass plays a vital role in oxygen production and absorption of carbon dioxide. It acts as a purifier in aquatic ecology. The seagrass area increases only when the water is clean. Seagrass will rejuvenate fishing ground by providing nursery habitat to important fish species," Mr. Nanda said.

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Another heartening outcome of the annual monitoring was reappearance of sponges. “Due to disturbance in habitat, the sponges were not observed in the lake after 1985. But after the recent eviction of large area of prawn gherry in the southern sector of the lake, the sponges are observed abundantly in Patanasi and Kumarpur area,” he said.

Some of the indicators that emerged during the monitoring established the lake’s resilient ecosystem. The annual survey of endangered Irrawaddy dolphins conducted finds population of aquatic mammals in the range of 130-150.

Northeast is home to six new lizards

Not just remote forests, even crowded cities could be hiding new species. Researchers have discovered six new species of bent-toed geckos – a type of small lizard – from northeastern India, and one of them is from Assam’s capital, Guwahati.

While researchers found the Guwahati bent-toed gecko (Cyrtodactylusguwahatiensis, named after the city) near a small hillock in the urban sprawl of Guwahati city, the Kaziranga bent-toed gecko, the Jaintia bent-toed gecko and the Nagaland bent-toed gecko have been discovered from Assam’s Kaziranga National Park, the Jaintia hills of Meghalaya and Khonoma village in Nagaland, respectively. The Abhayapuri bent-toed gecko is currently found only in the vicinity of Abhayapuri town in Assam’s Bongaigaon district, and the Jampui bent-toed gecko, only in Tripura’s Jampui Hills. All the new lizards belong to the genus Cyrtodactylus and are called bent-toed or bow-fingered geckos, named after their bent toes.

The discoveries – by an international team from institutes including Bengaluru’s National Centre for Biological Sciences and London’s The Natural History Museum – have been published in Zootaxa. The researchers first searched for geckos along, and south of, the Brahmaputra River in northeastern India.

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The team then studied in detail the physical features of the bent-toed geckos they spotted in these areas. They compared them with specimens of north-eastern geckos in museum collections across India and the world, including the United States and United Kingdom. They also extracted DNA from the specimens they collected and finally confirmed the six as species new to science.

Unknown natural history

These species are known only from a single locality each, and nothing is known of their natural history, ecology or distribution except that they are nocturnal and live on rocks, said the authors. “They are likely to be narrowly distributed endemic species,” said lead author Ishan Agarwal, who was with the Villanova University in the United States and began working on bent-toed geckos at Bengaluru’s Indian Institute of Science, a few years ago.

“Northeast India probably has dozens more bent-toed geckos,” he added.

The discovery increases the number of bent-toed geckos described from the Himalaya and north-eastern India to 15 (nine of which have been described this year alone). Since 2017, more than 20 new species of bent-toed geckos have been described from Myanmar, too. These new discoveries are a result of surveying areas that have never been sampled before from within the Indo–Burma biodiversity hotspot, said Agarwal.

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Rushikulya readied for olive ridleys mass nesting season

Arrangements by forest department are now in the final stages for the forthcoming mass nesting season of olive ridleys at Rushikulya coast of Odisha in February. Forest officials said the third phase of beach cleaning is going on. Preparations are on to put up a metal net wall on a stretch from Gokharkuda to Prayagi, the region where mass nesting occurs.

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India conducts 'largest coastal security drill'

Ten years after the 26/11 Mumbai terror attack, India conducted its largest coastal defence drill, Exercise Sea Vigil, to test its preparedness along the entire 7,516.6 km-long-coastline and exclusive economic zone of the country.

The first of its kind exercise was conducted on January 22 and 23 and coordinated by the Navy.

"Exercise Sea Vigil aims to comprehensively and holistically validate the efficacy of the measures taken since 26/11. It aims to simultaneously activate the coastal security mechanism across all 13 coastal States and Union Territories," the Navy said in a statement.

This involves the evaluation of critical areas and processes, including inter-agency coordination, information sharing and technical surveillance. "Multi agency audit and identification of gaps, shortfalls and incorporation of lessons learnt into Standard Operating Procedures (SOP) are also the desired outcomes," the Navy stated.

"In an effort to test the preparedness and coordination, some rogue elements tried to breach the surveillance network and reach the coast during the exercise," an official said.

Post 26/11, the Navy was designated as the agency responsible for overall maritime security, including offshore and coastal security, while the Coast Guard was designated as the agency responsible for coastal security in territorial waters.

A multi-tiered patrol and surveillance mechanism with focus on technical surveillance and augmenting Maritime Domain Awareness through the coastal radar chain was adopted.

Delayed start for CRZ regime in State

Kerala may have to wait for some time to take advantage of the new Coastal

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Regulation Zone (CRZ) notification for want of an approved Coastal Zone Management Plan (CZMP).

For the new notification to come into play, coastal States, including Kerala, will have to get their CZMPs prepared under the CRZ, 2011 notification updated in tune with the 2019 notification issued last week. The CZMP, prepared in consultation with various stakeholders, will define the development activities that could be undertaken along the coastal belt. Under normal circumstances, the CZMP shall not be revised in five years.

For Kerala, even the CZMP prepared under the 2011 notification has not been approved and the document is awaiting the nod of the National Coastal Zone Management Authority (NCZMA).

The thus notified CZMP will then have to be revised in tune with the 2019 notification and submitted for the approval of the Ministry. While revising the CZMP, the State will have to repeat the process of public hearing and inviting comments from all stakeholders regarding the changes it intends to make in the document.

It was after a delay of nearly three years that the State succeeded in preparing a CZMP.

Section 6 (1) of the CRZ, 2019 notification specifies that the new CRZ regime will not come into force unless the coastal States revise or update their respective CZMPs.

Norms to continue

It further states that “until and unless the CZMPs is so revised or updated, provisions of this notification shall not apply and the CZMP as per provisions of CRZ Notification, 2011 shall continue to be followed for appraisal and CRZ clearance to such projects.” Till the revised CZMP is approved, the CRZ, 2011 will have to be considered for clearing projects, according to the new notification.

According to those at the Kerala Coastal Zone Management Authority, the

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CZMP of the 10 coastal districts have been submitted to the NCZMA for approval. Once approved, the document could be revised in tune with the latest notification, they hoped.

Any changes in the CRZ notification will have far-reaching ramifications in the State, which has a nearly 580-km-long coastline and hundreds of thickly populated islands in its backwater and mainland coast. With its high population density and pressure from the tourism, industry and housing sectors, the management of the CRZ regime has always proved to be a tough task for the authorities.

Jumbos to patrol Odisha's Satkosia Tiger Reserve

Patrolling in the Satkosia Tiger Reserve is set to be strengthened as two trained elephants would be deployed there shortly.

Trained elephants will help ground-level forest guards patrol deep in the forest where jeeps cannot go.

The two elephants are being brought from the Similipal Tiger Reserve.

"We are mobilising a few trained elephants as per the guidelines of the National Tiger Conservation Authority. The elephant deployment in STR at present has no connection with the possible release of tigress Sundari, imported from Madhya Pradesh, from the special enclosure set up inside Satkosia," said Sandeep Tripathi, Principal Chief Conservator Forest (Wildlife).

Sources in the Forest and Environment Department said the authorities did not want to leave any stone unturned before approaching the NTCA for resuming the ambitious tiger reintroduction programme in Satkosia.

The tiger reintroduction programme in STR had run into rough weather following the death of India's first inter-State translocated tiger last year.

The Odisha government had planned to bring six tigers (three male and three female) from Madhya Pradesh to increase the feline population in Satkosia. Last year, one pair of big cats was brought to Satkosia.

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However, the programme did not go as per plan. While the tiger T1 reportedly died after falling into a poaching trap, there was huge discontentment among villagers residing in the buffer areas over the frequent straying of the tigress into human habitation. As the situation went out of control following a human kill, the tigress was captured. Subsequently, the programme was put on hold.

'

India can't handle more big cats'

While conservation efforts are aimed at increasing the tiger count in India, global experts and officials in the government suggest that India must also prepare for a new challenge — of reaching the limits of its management capacity.

Officially, India had 2,226 tigers as of 2014. An ongoing census is expected to reveal an update to these numbers. But Rajesh Gopal, head of the Global Tiger Forum, said that India's current capacity to host tigers ranged from 2,500-3,000 tigers.

Moreover, said another official, 25-35% of India's tigers now lived outside protected reserves.

With dwindling core forests as well as the shrinking of tiger corridors (strips of land that allow tigers to move unfettered across diverse habitat), officials said there were several challenges — alongside the traditional challenges of poaching and man-animal conflict — to India's success at tiger conservation. Recent attempts at translocating tigers to unpopulated reserves, such as Satkosia in Orissa, have ended badly, with one of the tigers dying.

Mr. Gopal was speaking at a conference of representatives from a group of countries who've signed a declaration to double tiger numbers by 2022, organised by the National Tiger Conservation Authority. Barring China, all other tiger-range countries — Thailand, Laos, Vietnam, Cambodia, Russia, Indonesia, Malaysia, Bangladesh, Bhutan, Myanmar, India and Nepal — were part of the conference in New Delhi .

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Another official, involved in the ongoing census said the report — expected to be made public in May — will also, for the first time, discuss challenges of having a thriving tiger population.

"Overall, given the low availability of prey in some reserves, this is the capacity that can be supported. However, there are vast tracts of potential tiger habitat that can be used to improve prey density, develop tiger corridors and therefore support a much larger population," said Y. Jhala of the Wildlife Institute of India (WII).

Over 10,000 tigers

K. UllasKaranth, director, Centre for Wildlife Studies, however, said, "I would estimate the potential carrying capacity for tigers in India at 10,000 to 15,000, not the 3,000 we already have. When tiger recovery efforts began 50 years ago we had about 2,000 tigers.. If after all this effort and expenditure, we are satisfied with just 3,000 tigers, it points at a serious management problem: needlessly huge amount of money is being dumped repeatedly on the same 25,000-30,000 sq. km area where tigers are already at saturation densities, while other areas with potential for future recovery are starved of key investments."

Since 2006, the WII has been tasked with coordinating the tiger estimation exercise. The once-in-four-years exercise calculated, in 2006, that India had only 1,411 tigers. This rose to 1,706 in 2010 and 2,226 in 2014 on the back of improved conservation measures and new estimation methods.

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Protect plantations and forests to minimise conflict

Acacia and eucalyptus plantations are notorious for the ecological problems they cause. Yet, in southwest Karnataka, these monocultures have become crucial elephant habitats and need to be protected along with natural forest patches to minimise human–elephant conflict, suggests a study published inTropical Conservation Science.

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Hassan, Madikeri

In Karnataka's Hassan and Madikeri — a landscape consisting of plantations (teak, coffee, acacia and eucalyptus), paddy fields and small, fragmented forest patches — human–elephant conflict is high. Reacting to this, authorities removed 22 elephants from the area in 2014. However, elephants from habitats nearby colonized the area again. With conflict rising, scientists at the Nature Conservation Foundation including Vinod Krishnan studied how the elephants — now approximately 30 in number — used 205 villages here between 2015 and 2017. They first tracked daily elephant movement (using direct observation and indirect signs such as dung). With this, they mapped the intensity of use of each village by elephants. This revealed that the large mammals were present across the landscape during the first year. However, the team found a high concentration of elephant presence in the northern part of the region in the second year. According to them, the logging of trees in abandoned coffee estates in the central zone, and the installation of barriers around these estates, clustered elephant presence in the north. This increased human–elephant conflict here, revealed an analysis of crop damage incidents and human casualties.

Habitat types

The team also mapped elephant distribution across different habitat types (such as reserved forests, agricultural fields and monocultures of acacia and eucalyptus) to study habitat use. During the day, elephants preferred monoculture refuges (of acacia, teak and eucalyptus) and forest fragments, and avoided other habitats including coffee and human habitations. But during the night, they used coffee plantations and agricultural fields the most. Seasons too played a role: while elephants used forests and coffee plantations more during the dry season, they frequented agricultural fields in the wet season.

Across the years, while the elephants' use of monoculture refuges and coffee

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increased, their use of forest fragments drastically decreased (from 15% to 2%). According to Krishnan, in areas where natural forests have been wiped out, monocultures — which serve as refugia for elephants and help them move between habitats — could help minimize human–elephant conflict and promote coexistence between people and elephants.

"Such refugia play a crucial role in keeping conflict levels low," said Krishnan, the lead author of the study.

Entire Aravalli area is devastated, rues annoyed Supreme Court

In a stinging attack on the Rajasthan government, the Supreme Court said the State authorities are hand in glove with illegal miners who operate in the fast-depleting Aravalli region.

A Bench led by Justice Arun Mishra was annoyed when the State's counsel submitted that the ground-truthing exercise to ascertain the area where illegal mining had allegedly been conducted remained incomplete due to the recently held Assembly elections and the upcoming Lok Sabha polls.

"What are you saying? As elections are there, so illegal mining will go on till then? What is this? You do not want to do this because this suits you. The entire machinery is rotten," the court asked.

Promise belied

The court said the once-lush Aravalli region is devastated after years of indiscriminate and illegal mining. "You are hand in glove and your officers are hand in glove with them (illegal miners). The entire Aravalli area is devastated and the entire flora and fauna there has gone," the apex court said.

The court recounted how the State had promised to finish the exercise in three months on October 29 last year and ordered the personal appearance of the State Chief Secretary.

'Only want compliance'

"We want compliance of our order. We want only compliance," the court said,

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refusing to give more time to the counsel to get instructions from the State.

The court had, in October, expressed shock over 31 "vanished" hills or hillocks in the Aravalli area and had asked the State to stop illegal mining in a 115.34-hectare area.

Train project will eat into forestland

The Mumbai-Ahmedabad high speed train corridor project was accorded wildlife clearance on January 10, according to records of the meeting of the committee chaired by Union Environment Minister Harsh Vardhan.

The Thane Creek Flamingo (TCF) Wildlife Sanctuary, which the project will eat into, came into being on August 2015 and the 1,690-hectare bird haven — 896 hectares of mangrove forests and 794 hectares of a water-body — is on the western bank of the creek, between the Airoli and the Vashi bridges connecting Mumbai and Navi Mumbai.

Apart from the creek, the project also involves diverting 32.75 ha of forestland and 77.30 ha of non-forestland from the Sanjay Gandhi National Park which houses leopards and transfer of 0.6902 ha of forest land and 4.7567 ha of non-forest land from the Tungareshwar Wildlife Sanctuary.

While according clearance, the National Board of Wildlife — the apex body tasked with according permissions to allow forest land to be diverted for industrial development — has laid pre-conditions for the bullet train project.

These include paying Rs. 10 crore (2% of 500 crore — the component of the project in Mumbai) for habitat improvement of the sanctuary, barricading the work site to ensure that no debris fall outside the project area and '… providing site and funds for penal plantation of at least 5 times the number of mangrove plants anticipated to be lost in this project..'

Largely funded by a soft loan by Japan, the Rs. 1 trillion Mumbai-Ahmedabad bullet train project has a track-length of 508 km, and will originate at the

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Bandra Kurla Complex, Mumbai and terminate at the Sabarmati, in Gujarat. The length across Maharashtra will be 155.64 km, 4.3 km across Dadra & Nagar Haveli, while the track length will be about 348.2 km in Gujarat.

Explain measures for tiger protection: High Court

Responding to a Public Interest Litigation (PIL) filed by a wildlife activist, the Telangana High Court directed the top brass of the Forest Department, including the Kawal Tiger Reserve Field Director, to explain measures taken by them to protect tigers in the State.

A Division Bench comprising Chief Justice Thottathil B. Radhakrishnan and Justice A. Rajasheker Reddy instructed the Chief Wildlife Warden, the Principal Chief Conservator of Forests and the Kawal Tiger Reserve Filed Director to personally appear before it and suggest steps taken for conserving wildlife. Along with tigers, all other wild animals, even birds, needed to be protected by the officials, the bench observed.

Field staff

For this, Forest Department officials and personnel working in the field needed to present their ideas and suggestions, the Bench observed.

Petitioner's counsel told the Bench that recently, within a span of one month, two instances of tiger death had been reported. While one died in the Pembi forest, the other was found dead on the outskirts of Shivaram of Jannarammandal in Mancherial district. Both died of electrocution.

Uncover truth

The bench remarked that it should be ascertained if the two tigers died because of the electric fence set up by people living in the forest for their protection or poachers had fixed it to kill wild animals.

The CJ observed that actually the electricity department officials should have been impleaded in the PIL. "How is power being supplied in forest area," the

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bench sought to know.

The judges observed that at an international conference some speakers had expressed the opinion that tigers would survive if they were left on their own and there was no need for any special measures for their conservation.

106 coastal sites picked for conservation

The Centre has identified over 100 coastal and marine sites as conservation reserves under its National Wildlife Action Plan for 2017-2031, a biennial report released by the government said.

As per the second biennial update report (BUR) of the Ministry of Environment and Forests, submitted to the UN body on climate change in December 2018, India is encouraging participation of local communities in governance by recognising the conservation reserves. "India is implementing measures to sustainably harness the potential of blue economy while building the climate resilience of the ecosystems and local coastal communities. Around 106 coastal and marine sites have been identified as conservation or community reserves to increase participation of local communities in governance," it said.

Half of waste-to-energy plants in India defunct

It also proposes setting up a Waste-to-Energy Corporation of India, which would construct incineration plants through PPP models. Currently, there are 40-odd WTE plants at various stages of construction.

"The fundamental reason (for the inefficiency of these plants) is the quality and composition of waste. MSW (municipal solid waste) in India has low calorific value and high moisture content. As most wastes sent to the WTE plants are unsegregated, they also have high inert content. These wastes are just not suitable for burning in these plants. To burn them, additional fuel

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is required which makes these plants expensive to run," said Swati Singh Sambyal, author of the report and researcher on waste management, at the CSE.

About 1.43 lakh tonnes per day (TPD) of municipal solid waste (MSW) are generated across the country. Of this, 1.11 lakh TPD (77.6%) is collected and 35,602 TPD (24.8%) processed.

In addition, India generates close to 25,940 TPD of plastic waste of which 15,342 remains uncollected, according to the Central Pollution Control Board.

As per the Union Ministry of Environment and Forests, MSW generation will reach 4.5 lakh TPD by 2031 and 11.9 lakh TPD by 2050.

The WTEs have also triggered widespread opprobrium among citizens. For instance, there has been a continuous protest against the Okhla WTE plant for polluting the environment.

In 2016, the National Green Tribunal (NGT) slapped environmental compensation fine of Rs. 25 lakh on the plant.

Moreover, the plants are expensive because they produce power at nearly Rs. 7 per unit, which is more than the Rs. 3-5 offered by thermal as well as solar sources.

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Moving continents created new centipede species

Fossils and advanced genetic methods to study relationships between species now tell an intriguing story about a group of tropical centipedes. Continental drift (the moving apart of continents) almost 100 million years ago created many species of Ethmostigmus centipedes in the world's tropics. In the Indian peninsula, these centipedes first originated in the southern and central Western Ghats, and then spread across the ranges here, finds a study published in BMC Evolutionary Biology .

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Diversity of species

India is home to six, fairly large Ethmostigmus centipedes: four dwell in the Western Ghats, one in the Eastern Ghats and one in north-east India. Africa, south-east Asia and Australia are also home to other species of Ethmostigmuscentipedes. What explains its distribution across continents and the diversity of species in peninsular India?

To find out, scientists Jahnavi Joshi and Gregory Edgecombe of the Natural History Museum (London, United Kingdom) turned to genetics. Using genetic data of 398 Ethmostigmus centipedes from published studies, they constructed a species 'time-tree' — a network that reveals how species are related to each other and when new species emerged — of nine species (across peninsular India, Africa, Australia and southeast Asia). They used three fossil centipedes to calibrate the DNA tree, which gave them the approximate times that the species originated in the past.

Common ancestor

The results suggest that a single ancestor gave rise to all Ethmostigmus centipedes in the ancient supercontinent of Gondwana (continents including Australia, Africa and peninsular India comprised this single landmass then). The subsequent breakup of Gondwana and the drifting away of different landmasses shaped the early evolutionary history of Ethmostigmus. And the Ethmostigmus in peninsular India are very unique, says co-author Joshi.

"They started evolving at a time when peninsular India was moving towards south Asia," she says. This started around 72 million years ago, in the southern and central Western Ghats. Following this, the Ethmostigmus here dispersed to the Eastern Ghats (now home to E. tristis).

From there, Ethmostigmus dispersed to the southern Western Ghats. Ethmostigmus centipedes also reached the northern Ghats from the south-central Ghats too, and later dispersed back to the central Ghats again from

there.

The formation of wet forests in these areas during this time could have aided this dispersal (for all existing peninsular Indian Ethmostigmus centipedes now dwell only in wet forests), write the authors in the paper.

What drives flowering, fruiting in Sikkim's rhododendrons?

Neems are in bloom and mango trees fruiting in many parts of India now, but what determines such seasonal changes? At least, in the Sikkim Himalaya temperature, day length and genetic relatedness between species determine when rhododendrons put out their first buds, flowers and fruits, finds a new study.

Interest in tree phenology — the timing of biological events such as flowering and fruiting — has increased after climate change has been shown to alter it, especially of plants in high-altitudes. But what abiotic factors play a role in such changes, and do closely-related tree species respond similarly to them? To find out, researchers at the Ashoka Trust for Research in Ecology and Environment including Shweta Basnett studied rhododendron trees in sub-alpine and alpine forests between 3,400-4,230 metres above sea level in Sikkim's Kyongnosla Alpine Sanctuary.

Between 2013 and 2015, the team monitored budding, flowering, fruiting (arrival of first fruits, immature green fruits and mature brown fruits) and fruit dehiscence (splitting open of fruit to release seeds) and the duration of phenology in 320 trees of 10 rhododendron species for every 15 days. Simultaneously, they collected data on temperature. Results from these, combined with data on day length in this region, reveal that the onset of budding, flowering and initial fruiting were mainly associated with a longer day length (around 13 hours) and higher temperature.

Relatedness matters

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The team also collected DNA from leaves of each species to see how genetically closely-related the 10 rhododendrons species are, to analyse if this plays a role in their phenological patterns. Relatedness did indeed influence early phenology events: closely-related species put out their first buds, flowers and fruits together.

But when resources (sunshine as reflected by day length, and temperature) decreased as winter neared, all rhododendrons experienced later phenology events — the arrival of immature green fruits, mature brown fruits and finally, fruit dehiscence — regardless of whether they were closely related or not, says Basnett. Similarly, relatedness did not play a role in phenology of rhododendrons with increasing altitude. Harsher environments at higher elevations — including lower temperatures, heavy snowfall and barren and rockier lands higher up — could be trumping over the species' common evolutionary history here, write the authors in their study published in Ecosphere.

"Different factors play a role in rhododendron phenology and the study contributes to baseline information about the species in India and the world," added Basnett.

Great Indian hornbills can adapt to modified habitat: study

Amid a changing environment, with natural homes of birds getting depleted as natural forests make way for plantations and other such modified terrain, comes the good news of how the great Indian hornbill (Bucerosbicornis) adapts to such change. A group of researchers from NCBS-TIFR in Bengaluru and Nature Conservation Foundation in Mysuru observed eight hornbill nests, three located in contiguous forests and five located in modified habitats such as coffee plantations. They found that the birds followed similar nesting behaviour but adapted to the changed environment. The study is published

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in the journal Ornithological Science.

The team chose to study the great Indian hornbills nesting in the Anamalai hills. For comparison, the researchers located the study in the modified habitat in the Valparai plateau and the contiguous forests in the Anamalai Tiger Reserve and the Vazhachal Reserve forests. The modified habitat included tea, coffee and cardamom plantations and tribal settlements. “Most of the nests were known to us as we have been studying hornbills and monitoring them for many years now. Some of the nests were discovered during the study with the help of local tribal assistants,” says T R Shankar Raman of Nature Conservation Foundation and an author of the paper, in an email to The Hindu . Describing the mode of observation, he says: “We started monitoring nests from the beginning of breeding season in December. After the females had entered the nests, we conducted direct nest observations on multiple nests using standard field protocols and taking care not to disturb the birds…All observations were done manually.”

Nesting habits

Hornbills are secondary cavity nesters and choose cavities formed in large trees for nesting. Also they are monogamous, and the female, after copulation, seals herself in the hole until the initial breeding period of two-four months is over. During this time, the female and the young ones are fed by the male bird, with fruit such as figs and animal matter. So, in principle, along with other threats such as hunting, modified land use, ensuing forest fragmentation, felling of large trees with the potential for nesting, the loss of fruit bearing trees could also affect hornbill nesting habits.

“Great hornbills may adapt to habitat modification provided that their key requirements for food and nesting are fulfilled in the habitats like coffee and forest fragments,” says Pooja Pawar from NCBS-TIFR and the first author of the paper.

Considering that hornbills use same nest over years, protection of these

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known nest trees and retention of large trees that can be potential nests is absolutely essential. In addition, it would be necessary to have a diversity of native tree species, particularly figs, laurels and other food plants, the study concludes. “We also highlight the potential of rainforest fragments and coffee plantation for conservation of hornbills outside of protected areas,” she adds.

‘Much to gain if Paris climate goals are met’

India could save at least $3 trillion (Rs. 210 trillion approx.) in healthcare costs if it implemented policy initiatives consistent with ensuring that the globe didn’t heat up beyond 1.5 degrees Celsius by the turn of the century, says the sixth edition of the Global Environmental Outlook (GEO), prepared by the United Nations Environment Programme.

“Damage to the planet is so dire that people’s health will be increasingly threatened unless urgent action is taken….Unless environmental protections were drastically scaled up, cities and regions in Asia, the Middle East and Africa could see millions of premature deaths by mid-century,” a press statement accompanying the report noted.

India’s stated commitment is to lower emissions intensity of its GDP by 33-35% compared to 2005 levels by 2030; increase total cumulative electricity generation from fossil free energy sources to 40% by 2030, and create additional carbon sink of 2.5 to 3 billion tons through additional forest and tree cover.

India is on track to achieve two of these goals — of emissions intensity and electricity generation — according to independent climate-watch site Climate Tracker.

However these actions are only enough — and provided other countries too live up to their commitments — to limit temperature rise to 2 degrees.

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For India to leapfrog onto a 1.5-degree pathway it would have to "abandon plans to build new coal-fired power plants," said Climate Tracker's most updated analysis as of Dec 2018.

A climate vulnerability index for India on the anvil

The Department of Science and Technology (DST) will be commissioning a study to assess the climate risks faced by States in India. This follows an assessment of the global warming risks faced by 12 Himalayan States — and discussed at last year's U.N. climate change conference in Poland — that found States such as Assam, Arunachal Pradesh and Uttarakhand vulnerable to climate change.

"We eventually hope to have a climate portal, whereby users can zoom in on any district in the country and get a sense of what kind of risks — climate, socio-economic — are present," said Ashutosh Sharma, Secretary, DST.

Common methodology

Last year the Indian Institutes of Technology (IIT) at Mandi and Guwahati, and the Indian Institute of Science (IISc), Bengaluru, coordinated with State authorities in Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Arunachal Pradesh, Sikkim, the hill districts of West Bengal, Himachal Pradesh, Uttarakhand and Jammu and Kashmir, to evolve a common methodology, and determine how districts there are equipped to deal with the vagaries of climate change.

The researchers prepared a 'vulnerability index' of each of these States based on district-level data. Vulnerability would be a measure of the inherent risks a district faces, primarily by virtue of its geography and socio-economic situation.

The scientists conducted workshops with the States and culled eight key parameters on the basis of which a vulnerability score could be generated.

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They included: percentage of area in districts under forests, yield variability of food grain, population density, female literacy rate, infant mortality rate, percentage of population below poverty line (BPL), average man-days under MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act), and the area under slope > 30%.

On a scale ranging 0-1, 1 indicating the highest possible level of vulnerability, at the top of the scale were Assam with a score of 0.72 and Mizoram at 0.71, whereas Sikkim, with an index score of 0.42 was relatively less vulnerable. "This doesn't mean that States with a lower score are safe in an absolute sense. In fact, some districts in Uttarakhand [at 0.45 and at the lower end of the scale] are more vulnerable than those in Assam," said Shyamasree Dasgupta, Assistant Professor, IIT-Mandi, one of the key authors of the report.

Different factors

Different factors contributed to a State's vulnerability. In Arunachal Pradesh, the key factors are low female literacy and high percentage of population above BPL whereas in Nagaland the key issues are loss of forest cover, steep slope and high yield variability.

Akhilesh Gupta, a senior coordinator of the initiative at the DST said that the over-arching aim of the analysis was to give actionable inputs to States.

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Bio-medical waste: NGT warns States

The National Green Tribunal has directed all States and Union Territories to furnish reports pertaining to the management of bio-medical waste (BMW) to the Central Pollution Control Board (CPCB) by April 30.

Noting that non-compliance of bio-medical waste management rules is "widespread," a Bench headed by NGT chairperson Justice Adarsh Kumar Goel warned of heavy fines on authorities if they fail to furnish reports.

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"We direct all States and Union Territories to ensure that reports [in terms of relevant rules] are furnished to the CPCB within one month or on or before April 30, for the period the reports are due as per rules. The CPCB may furnish a status report of compliance of BMW rules after proper analysis to NGT within one month," the Bench said.

It added, "It is made clear that any failure will result in the defaulting States being required to pay compensation to be deposited with the CPCB at the rate of Rs. 1 crore per month after May 1."

Action plans

The States have also been directed to prepare respective action plans for compliance of rules pertaining to BMW within one month.

"The CPCB may give its comments on the action plan to NGT within one month, thereafter," the Bench said.

Further, the green panel directed the apex pollution monitoring body to undertake a study and prepare a scale of compensation to be recovered from "violators of BMW rules" within one month.

"This will not debar the State pollution control boards from performing their duty of recovering compensation from the polluters or laying down their own scale, which should not be less than the scale fixed by CPCB. The scale must be deterrent rendering violation of rules to be non-profitable and which should be adequate to remedy the situation," the Bench said.

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NGT suspends expansion of thermal plant

The Principal Bench of National Green Tribunal (NGT), New Delhi, has ordered the suspension of the Environmental Clearance of August 1, 2017, granted for the expansion of the thermal plant of Udupi Power Corporation Ltd. (UPCL) at Yellur in Udupi district by addition of 2 x 800 MW units to raise ultimate capacity to 2,800 MW.

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The copies of the order of the tribunal issued on March 14, along with a press note, were released here by Balakrishna Shetty, executive president, Nandikur Janajagrithi Samithi, an NGO, which has been opposing the thermal power plant at Yellur in Udupi district. The tribunal held that clearances granted for the setting up of the power plant were illegal. The tribunal invoked the "Polluter Pays" principle and appointed a Committee of Experts to ascertain damage to crops and environment in the area. This committee shall assess the damage on account of environmental violations in the areas of fly ash management, ash pond, ambient air quality and fugitive emissions, which had damaged the environment and ecology and submit its report in three months. Awaiting this report, the tribunal directed UPCL to pay Rs. 5 crore as interim environmental compensation to the Central Pollution Control Board (CPCB). The compensation would be subject to the assessment of final damages by the Committee of Experts. It directed the State government to conduct a study of carrying capacity of the area. It also ordered the company to pay Rs. 1 lakh as cost to the petitioners.

The thermal plant project was challenged in 2004 by the samithi before the then National Environmental Appellate Authority (NEAA), New Delhi. The appeal was dismissed by the sole non-judicial adjudicator. It then filed a Writ Petition before the High Court of Karnataka in 2005. The BellibettuAladeDevasthana and CSI St. Luke's Church also filed Writ Petitions before the High Court.

The cases were transferred to the National Green Tribunal, South Zone, Chennai, in 2012. Due to the lack of judges in the Zonal Tribunal at Chennai, the cases were finally heard by the Principal Bench at New Delhi, the release said.

UN meet dilutes Indian plan to phase out single-use plastics

An ambitious resolution piloted by India to phase out single-use plastics

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by 2025, was watered down at the United Nations Environment Assembly (UNEA) that concluded in Nairobi.

At the World Environment Day summit on June 5, 2018 here, Union Environment Minister Harsh Vardhan, in the presence of Prime Minister Narendra Modi, had pledged to eliminate single-use plastics from India by 2022. This was lauded by then UN Environment Chief, Erik Solheim.

This pushed several States — notably Maharashtra, Tamil Nadu and Himachal Pradesh — to enforce previous commitments to ban plastic bags and similar disposables.

Ahead of the UNEA, the UN secretariat had invited inputs from member states to forge a common declaration regarding addressing a host of environmental challenges. India's inputs on the February 16 read:

"…We will decisively address the damage to our ecosystems caused by the unsustainable use and disposal of single-use plastic products, including by phasing-out most problematic single-use plastic products as early as 2025, and we encourage the private sector to find affordable and eco-friendly alternatives…"

Deadline pushed back

However, the final declaration on March 15 removed the firm timelines and edited out the "decisively" and only committed to a "reduction by 2030."

"…We will address the damage to our ecosystems caused by the unsustainable use and disposal of plastic products, including by significantly reducing single-use plastic products by 2030, and we will work with the private sector to find affordable and environment friendly alternatives…" says the document available on the UNEA website.

The UNEA, however, lauded India for playing a key role in advocating a time-bound ban on single use plastic. A person privy to negotiations told The Hinduthat India didn't work enough to garner international support to carry it

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all the way through. “We didn’t have enough subject experts at Nairobi,” he added.

Nitrogen pollution

Along with plastic, India also piloted a resolution on curbing nitrogen pollution.

“..The global nitrogen-use efficiency is low, resulting in pollution by reactive nitrogen which threatens human health, ecosystem services, contributes to climate change and stratospheric ozone depletion. Only a small proportion of the plastics produced globally are recycled, with most of it damaging the environment and aquatic bio-diversity. Both these are global challenges and the resolutions piloted by India at the UNEA are vital first steps towards addressing these issues and attracting focus of the global community,” said a press statement by the Union Environment Ministry.

A top official in the Ministry told The Hindu that India’s commitment to phase out plastic would continue irrespective of the global resolution. “It’s a significant step that such a resolution was accepted at the UN. Timelines per se are matters of further negotiation and debate,” Secretary, Union Environment Ministry C.K. Mishra said. “However, our commitments and efforts to reduce plastic use will continue at our pace.”

A Central Pollution Control Board estimate in 2015 says that Indian cities generate 15,000 tonnes of plastic waste daily and about 70% of the plastic produced in the country ends up as waste. Seventeen States have plastic bans, on paper. Experts have rued the inadequacy of collection and recycling systems to address the burgeoning plastic waste problem.

Pushing the purple frog to the edge

The rare and endangered soil-dwelling purple frog (Nasikabatrachussahyadrensis) begins its life as a tadpole in certain fast-

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flowing streams of the Western Ghats. Scientists have now found that the speed with which water flows down these streams is one of the main factors that determine the presence and aggregation of these tadpoles.

The tadpoles are rheophilic, which means they thrive in running water. Apart from several other body adaptations, their specialised mouthparts, which are like suckers, help them to anchor onto rocky areas in flowing water for nearly 100 days. So what are the characteristics of a stream that help the tadpoles survive?

Behavioural insights

To find out, researchers at the University of Delhi and the Kerala Forest Research Institute quantified four stream characteristics: water flow velocity; angle of the rocky base; water depth, and water temperature. The study, in Kerala, was restricted to 68 grids placed along 100 m in two streams at Kulamaav in Idukki district, an area the team already knew was home to the purple frog.

Their results, published in the Journal of Asia-Pacific Biodiversity , show that the team spotted 550 tadpoles in these grids. Though found throughout the streams, the tadpoles tended to gather in large numbers only in areas with relatively higher water flow velocity. They also preferred steep, rocky slopes (65°-90° incline) and a water depth of 2-3 cm.

The team made observations on tadpole behaviour and distribution too. The tadpoles were always active, moving even when they were attached to the rocky portions of the streams to feed on algae growing on rocks. The moment they sensed danger, they 'escaped by immediately relaxing their hold on the rock, a behaviour that let them drift some distance downstream before re-attaching themselves to the substrate. Tadpoles in earlier stages of development stayed mostly in relatively slow-flowing portions of the stream', while older tadpoles were found in faster currents.

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Specific threats

According to the authors, these findings and observations provide "a strong rationale linking the impact of dam construction to loss of tadpole habitat". Ashish Thomas, lead author of the study, says the construction of dams and check dams, and levelling and narrowing of streams to expand plantations can alter stream characteristics, in turn affecting the survival of the purple frog tadpole. The damming effect can also slow down the streams feeding water to the river.

He adds, "We hope to now study tadpoles in such modified streams and natural ones to understand this better."

Pollution: 6 States told to submit action plan

The National Green Tribunal (NGT) has directed six States to submit by April 30 action plans for bringing air quality standards within the prescribed norms, failing which they would be liable to pay environment compensation of Rs. 1 crore each.

A Bench headed by NGT Chairperson Justice Adarsh Kumar Goel ordered the Chief Secretaries of Assam, Jharkhand, Maharashtra, Punjab, Uttarakhand and Nagaland governments to submit their plan within the stipulated time.

"We direct Chief Secretaries of the States in respect of which action plans have not been filed to forthwith furnish such action plans," the Bench, also comprising Justices S.P. Wangdi and K. Ramakrishnan, said.

Rs. 25 lakh for deficiency

The States, where action plans are found to be deficient and deficiencies are not removed till April 30, will be liable to pay Rs. 25 lakh each and the timeline for execution of the action plans is six months from the date of their finalisation, the Bench said.

It said that budgetary provision must be made for execution of such plans.

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The tribunal warned that if action plans are not executed within the specified timeline, the defaulting States will be liable to pay environmental compensation and may also be required to furnish performance guarantee for execution of plans in extended timeline as per recommendations received from the Central Pollution Control Board (CPCB).

"The CPCB is directed to update the number of cities. If on parameters applied, there are other cities, not included in list of 102, they may be also included," the NGT said.

The direction came after the CPCB informed the green panel that out of 102 cities, action plan has been received from 83 cities, while 19 have not submitted it.

The tribunal will take up the matter for further consideration on July 19.

'Carrying capacity'

Concerned over the threat posed to limited natural resources due to their overuse, the tribunal has directed assessment of carrying capacity of 102 cities, including Delhi, where the air quality does not meet the national ambient air quality standards.

The concept of "carrying capacity" addresses the question as to how many people can be permitted into any area without the risk of degrading the environment there.

The tribunal had said the Ministry of Urban Development in coordination with the CPCB, Ministry of Transport, authorities such as Planning Commission and States, may carry out such study with the assistance of experts in the field.

It had said that it is undisputed that air pollution is a matter of serious concern and large number of deaths take place every year in the country on account of air pollution.

The NGT had said that Delhi is over-polluted and figures quite high in the

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ranking of most polluted cities and there is no study about the capacity of the city with respect to the extent of population which can be accommodated and number of vehicles which can be handled by its roads.

El Nino gains strength, may impact monsoon

El Nino, characterised by a warming of surface temperatures in the Pacific Ocean, is associated with lower than normal monsoon rainfall in India. The El Nino weather phenomenon is gaining strength, latest global forecasts indicate, potentially affecting the South-west (June to September) According to the US National Oceanic and Atmospheric Administration, there is an 80% chance that El Nino will prevail in March-May, decreasing to 60% during the June-August period, when the South-West monsoon normally arrives.

El Nino affects the flow of moisture-bearing winds from the cooler oceans towards India, negatively impact the summer monsoon, which accounts for over 70% of annual rainfall. It remains to be seen how it would actually evolve over the next few months, but if it does retain its strength after the summer, it could mar the prospects of a good monsoon in India.

"We have to wait till April or May to ascertain El Nino's impact on the monsoon," said D.S. Pai, senior scientist at the India Meteorological Department, Pune. IMD forecast models suggest that weak El Nino conditions are likely to persist in the early part of the summer and weaken thereafter. "Once El Nino sets in, it continues for around 12-15 months and subsides in next pre-monsoon season. On some rare occasions, it may start late, gains strength and then decay before the monsoon onset. So, it could happen too," said Pai.

Contrary to last year's global forecasts indicating that El Nino would form around October 2018, its formation was confirmed in February this year.

"During the next several months, El Nino can keep evolving and gain strength.

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Generally, it achieves its peak in winter. But how and when it will intensify, we cannot say. We will have to keep close eye on the forecast for next two months," said R Krishnan, senior scientist at Indian Institute of Tropical Meteorology (IITM), Pune.

Even though it is weak at present, forecasters said El Nino has become more marked than last month. An El Niño of any strength can reduce the amount of monsoon rainfall and thus have significant local impact.

There is increase in both the sea surface temperatures and subsurface ocean temperatures, allowing weak El Nino to persist for at least next several months. Nevertheless, India is set to witness warmer than normal temperatures due to El Nino, which would be evident during the next three months.

Rushikulya waits for Olive Ridleys

Even after waiting for almost a month, Olive Ridley turtles have not yet arrived for mass nesting at Odisha's Rushikulya rookery and Devi river mouth. The reasons are not fully understood yet.

Mass nesting has already occurred at the Gahirmatha coast of the State.

Wildlife Institute of India's (WII) scientist BivashPandav said it could not be said for sure whether mass nesting would occur or not at the Rushikulya rookery this year. According to Mr. Pandav, who has studied mass nesting along the Odisha coast over the past decades, mass nesting of Olive Ridleys can occur up to any time till the end of April.

Berhampur Divisional Forest Officer (DFO) Ashis Behera said that, till now, lakhs of impregnated female Olive Ridleys are continuing to congregate in the sea near the Rushikulya rookery, but they aren't approaching the beach for mass nesting. "Sporadic nesting is continuing at this coast since February. Till now, over 1,000 mother turtles have nested at the Rushikulya rookery," said Mr. Behera.

"Although it is held that climatic parameters as well as beach conditions

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decide mass nesting at a coast, we are still not sure how these parameters affect their decision-making," said Mr. Pandav.

The Forest Department has readied six artificial hatcheries to incubate eggs resulting from sporadic nesting. The beach has been cleaned up. A metal net fences a stretch of over five kilometres from Gokharkuda to Prayagi — this fencing is expected to protect Olive Ridleys and their eggs from predators and human intervention. CCTV cameras continue to keep a watch on the nesting beach.

This year, the Forest Department also prepared a three-km-long coast near the Bahuda river mouth, from Sunapur to Anantpur, as an alternative mass nesting site, about 20 km to the south of Rushikulya. However, except for few occurrences of sporadic nesting, mass nesting has yet not occurred at this new beach.

India's carbon dioxide emissions up 5%

India emitted 2,299 million tonnes of carbon dioxide in 2018, a 4.8% rise from last year, according to a report by the International Energy Agency (IEA). India's emissions growth this year was higher than that of the United States and China — the two biggest emitters in the world — and this was primarily due to a rise in coal consumption. China, the United States, and India together accounted for nearly 70% of the rise in energy demand.

India's per capita emissions were about 40% of the global average and contributed 7% to the global carbon dioxide burden. The United States, the largest emitter, was responsible for 14%.

As per its commitments to the United Nations Framework Convention on Climate Change, India has promised to reduce the emissions intensity of its economy by 2030, compared to 2005 levels. It has also committed to having 40% of its energy from renewable sources by 2030 and, as part of this, install 100 GW of solar power by 2022.

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However the IEA report, made public , showed that India's energy intensity improvement declined 3% from last year even as its renewable energy installations increased 10.6% from last year.

Global energy consumption in 2018 increased at nearly twice the average rate of growth since 2010, driven by a robust global economy and higher heating and cooling needs in some parts of the world. Demand for all fuels increased, led by natural gas, even as solar and wind posted double digit growth. Higher electricity demand was responsible for over half of the growth in energy needs. Energy efficiency saw lacklustre improvement. As a result of higher energy consumption, carbon dioxide emissions rose 1.7% last year and hit a new record, the authors of the report said in a press statement.

The United States had the largest increase in oil and gas demand worldwide. Gas consumption jumped 10% from the previous year, the fastest increase since the beginning of IEA records in 1971.

India says it will cost at least $2.5trillion (Rs. 150 trillion approx.) to implement its climate pledge, around 71% of the combined required spending for all developing country pledges.

Protected areas matter to bumphead parrotfish

The survival of the threatened bumphead parrotfish in the Andaman and Nicobar Islands hinges on the persistence of coral reefs and presence of marine protected areas. Implementing fishing regulations could help its population bounce back, say researchers.

Bumpheads are the world's largest parrotfish. Ramming its enormous green head against corals to dislodge them, a single bumphead can nibble up to five tonnes of coral every year. Though seemingly destructive, this activity promotes coral growth and keeps reef ecosystems healthy. However, numbers of bumphead parrotfish have decreased worldwide. Overfishing is a concern, for the fish are highly prized catches. But how are India's bumpheads in the

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Andaman and Nicobar Islands doing?

In an effort to generate baseline data, a team comprising Vardhan Patankar (Wildlife Conservation Society-India) surveyed 75 coral reef sites off 51 islands to obtain information on the distribution of bumpheads. Diving underwater, they counted the numbers of bumpheads and quantified benthic cover (such as live coral, algae, sand and rubble) there. Their results, published in Oryx, reveal that the fish occurred only patchily in these waters at densities of just 0.0032 per hectare. The team spotted no juveniles, only 59 adults at merely nine islands.

"The low densities are shocking, very similar to those of bumphead populations in southeast Asia where they are legally protected," said Dr. Patankar.

Live coral cover and the presence of marine protected areas – where fishing is banned – emerged as crucial factors for bumphead presence. To supplement this information with local knowledge, the team also conducted 99 interviews with fishermen in the South and Middle Andaman islands and Central Nicobar. Most fishers were aware of the presence of bumpheads in their waters; and all fishermen in Central Nicobar and Middle Andaman had seen the fish feeding and aggregating (bumpheads tend to aggregate in numbers larger than 10). Most fishers had hunted the fish all their lives, using hand-held wooden spears or harpoons.

Currently, this hunting is only opportunistic. However, if this changes to targeted fishing it could endanger bumpheads which could be easily conserved as a 'flagship species', says Dr. Patankar. "Bumpheads are not legally protected in India though the IUCN categorises them as Vulnerable," he says. "Now would be a good time to protect them legally and implement some fishing restrictions so their numbers can improve. Natural catastrophes such as bleaching may have already affected these large fish."

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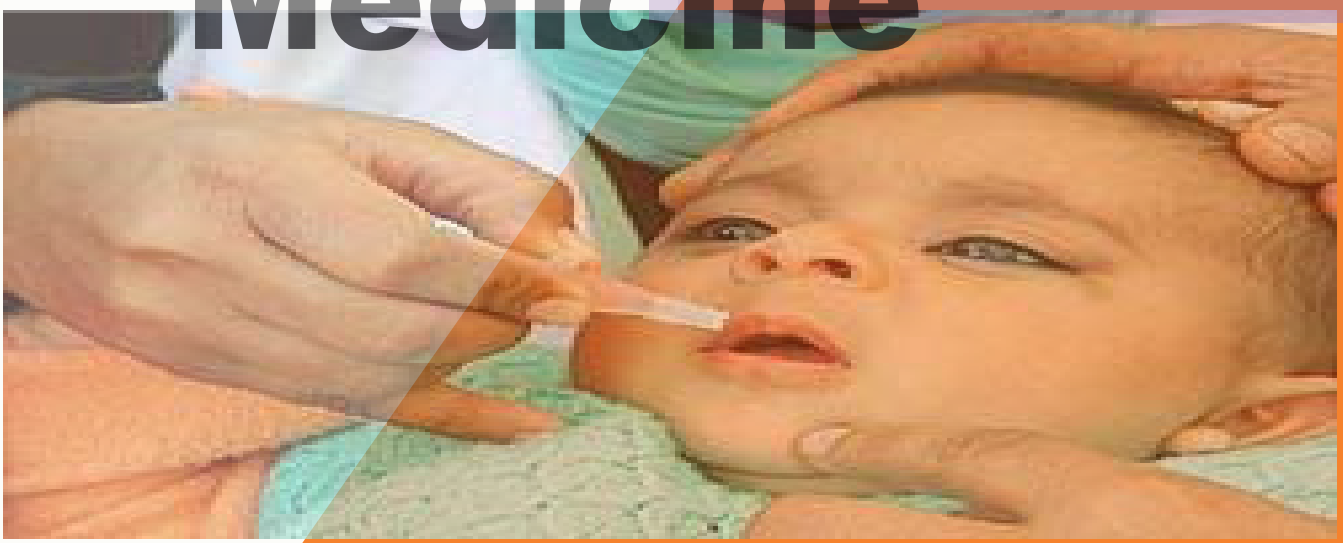

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The lowdown on blood transfusions

A young pregnant woman in a government hospital at a rural centre in south Tamil Nadu's Madurai district made an explosive revelation mid-December. Expecting her second child, she heard from doctors, after she was admitted following a bout of sickness, that she had tested positive for HIV.

Later, as the story unravelled, in full media glare, it turns out she had acquired the virus after a blood transfusion in a district hospital following a diagnosis of anaemia. This opened up a Pandora's Box, and fear and distrust pervaded the community. Besides flagging the issue of the availability of safe blood in the State, it set in motion a sequence of events, mostly tragic, introspection, and some corrective action.

The story did not end, or even begin, there. The blood donor, who had donated as a replacement donor when a pregnant relative required a transfusion, only discovered his HIV positive status after a test for a job interview. He rushed back to the hospital, laden with guilt, to inform authorities. By then, his blood had been transfused to the pregnant woman, and she had tested positive. His blood donation history retrospectively exposed chinks in the blood donation and transfusion cycle in at least two instances. He had already donated blood in 2016, but his blood was discarded after he tested positive for HIV. However, though the HIV law mandates that the patient be informed with counselling about his/her status, in this case the donor remained in the dark. In the second instance, when he donated his blood in November last year, two years after the first, the lab failed to test and/or detect his infection, which was clearly not in the 'window period' where the virus may avoid detection. The donor was distraught, and attempted suicide, and died in hospital later.

A few days later, another pregnant woman claimed she had been transfused with HIV-infected blood at Kilpauk Medical College and Hospital in Chennai. While her claim has been contested stoutly, the two incidents have, nevertheless, rocked the State that once won plaudits for its prevention of transmission

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programmes.

There is a chain of approved processes to be followed in blood donation, aimed at quality control and negating the possibility of transmitting infections. Every qualified donor is put through a basic clinical evaluation (blood pressure and pulse). If normal, a sample of the blood donated is tested for HIV, Hepatitis B and C, sexually transmitted diseases and malaria. Meanwhile, the donated blood is stored separately in an 'unscreened refrigerator.' If the sample clears these tests, or if the tests turn negative, the blood will then be moved to the 'screened refrigerator.' If it tests positive for any of the infections, another sample from the same blood bag is tested again. If positive, the bag is discarded. The HIV Act mandates that the blood bank inform the positive donor, besides referring to the appropriate department for further treatment. When a requirement crops up, the blood bank does a grouping to confirm that the group is the same, does a cross-match with the recipient and releases it to the ward.

The Madras High Court has sought a report from the Health Department. The National and State Human Rights Commissions have taken suomotucognisance of the issue and asked for the State's response. The need, however, is to build confidence in the community that the most exacting standards are followed in collecting, testing and storing blood, and then in transfusing it. Even if this calls for a re-look at the entire process, it must be done. It is as crucial as making sure no one dies because they could not get blood in time.

Crop burning raises risk of respiratory illness threefold, says IFPRI study

The burning of agricultural residue — a contributor to north India's winter pollution — increases the risk of respiratory illnesses threefold for those who experience it. It may also be responsible for an annual $30 billion (approximately Rs. 2 trillion) loss in terms of days of work lost in States

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affected by crop burning, according to a study by the International Food Policy Research Institute (IFPRI).

Health records

The findings were based on a study of the health records of 250,000 people in Haryana (which sees a spike in crop burning episodes in winter), and Andhra Pradesh and Tamil Nadu, which don't see similar burning episodes. The study is to appear in the peer-reviewed International Journal of Epidemiology.

The researchers used health records and satellite data from September 2013-February 2014. The satellite data was for crop-burning fires detected by the Moderate-Resolution Imaging Spectroradiometer (MODIS) Terra satellite, managed by the National Aeronautics Space Administration (NASA).

"We found that living in an area where crop burning is practised was a leading risk factor for respiratory disease in northern India. Whereas the total burden of diseases from air pollution declined between 1990 and 2016 due to efforts to reduce the burning of solid fuel for household use, outdoor air pollution increased by 16.6%," the researchers said in a statement.

'Absent in South'

In Haryana, 5.4% of surveyed individuals reported suffering from ARI (Acute Respiratory Infection) whereas the reported ARI symptoms in southern States was only 0.1%.

Among those who reported suffering from ARI, 83% also reported receiving treatment for ARI at a private or public medical facility.

Whereas high-intensity fire exposure was virtually absent in south India, 17.5% of individuals in Haryana lived in a district where 100 or more fires per day were observed by the satellite.

Living in a district that saw 100 fires a day was the "leading risk factor" for ARI. These trumped factors such as cracker burning in Diwali, being a child below 5 years of age and, living in a district with high motor vehicle congestion. The study was co-authored by IFPRI's Dr. Samuel Scott and Dr.

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Avinash Kishore; CGIAR Research Program on Agriculture for Nutrition and Health's Dr. Devesh Roy; University of Washington's Suman Chakrabarti; and Oklahoma State University's Md. Tajuddin Khan.

'First victims'

"Our study shows that it is not only the residents of Delhi, but also women, children and men of rural Haryana who are the first victims of crop residue burning. Much of the public discussion on the ill-effects of crop residue burning ignores this immediately affected vulnerable population," said Dr. Kishore.

For about a decade now, Delhi has been complaining about the practice of stubble burning, holding it responsible for the abysmal air quality in the capital in winter.

'Zero tolerance'

In 2013, the National Green Tribunal (NGT) issued a directive to Punjab, Haryana and Uttar Pradesh, asking them to ban stubble burning.

The Environment Ministers of these States as well as top officials at the Centre declared a "zero tolerance" policy on the burning of stubble, which has been estimated to contribute anywhere from 7% to 78% of the particulate matter-emission load in Delhi during winter.

Cancer drugs 87% cheaper after trade margin cap

After the trade margin on 42 anti-cancer drugs was capped to 30%, prices of nearly 390 cancer medications have fallen by 87%. The new MRPs came into effect from Friday.

The National Pharmaceutical Pricing Authority (NPPA) has put out the list on 390 drugs on their website.

"On 27 February, 2019, NPPA had put 42 anti-cancer drugs under the 30% trade margin cap. Manufacturers and hospitals were directed to convey

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revised MRP, to be effective from 8th March based on the Trade Margin (TM) formula; 390 brands i.e. 91% of the 426 brands reported by manufacturers, showed downward price movement," a press statement said.

In support

The trade margin cap has been hailed by health activists and doctors.

According to NPPA, nearly 38 medicines show price reduction of 75% and above after the cap.

Amity University achieves faster healing of diabetic wounds

Hydrogel nanotubes containing ice in a helical structure have been found to accelerate diabetic wound healing, according to a study by a multi-institutional team led by researchers from Amity University, Noida. They could achieve complete healing in 16 days in Wistar rats. No drug was used. In comparison, wound healing was only 80% in the control group. The team did not observe any scarring at the wound site in rats in the treatment group. As a result, reappearance of fur was seen at the wound site in these rats.

While diabetes leads to compromised blood flow leaving the cells at the wound site poorly nourished, the use of hydrogel nanotubes developed by the team led by Prof. Monalisa Mukherjee from Amity Institute of Click Chemistry Research and Studies led to early appearance of new blood vessels.

"Besides biocompatibility, the hydrogel nanotubes were found to facilitate quicker proliferation and migration of epithelial cells, fibroblasts and keratinocytes to the wound bed. This led to faster wound healing," says Rohan Bhattacharya from Amity University and one of the authors of a paper published in the journal Materials Horizons . "The moist environment provided for a prolonger period by the hydrogel nanotubes also hastened the wound healing process."

"The hydrogel nanotube can be used as a medicament which can control wound moisture, absorb inflammatory cytokines and dead cells from the

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wound and form a barrier to microbes," says Prof. Mukherjee.

Synthesis of hydrogel

The researchers synthesised the hydrogel nanotubes through a facile, cost-effective, template-free method to polymerise two monomers at 40 degree C using water as solvent and an initiator. During polymerisation, water gets trapped inside the mesh matrix and gets nanoconfined. "Initially we observed 2D polymer nanosheets where water locked within the polymer mesh became hexagonal ice due to nanoconfinement," says Prof. Mukherjee. "Water to ice conversion takes place at 40 degree C due to pressure caused by nanoconfinement."

As polymerisation proceeds, the polymer nanosheets get stacked one above the other. When many sheets get stacked, pressure is exerted on the bottom sheets by the sheets above leading to buckling and folding of the sheets into 1D nanotubes.

While bulk water present between the sheets gets squeezed out due to pressure, some water gets trapped within the hollow tubes as nanodroplets. Due to nanoconfinement inside the hollow tubes, the water gets converted into ice. The ice that is formed is octagonal in shape. "The ice closer to the wall binds to it while ice that is away from the tube remains free and unbound. To attain a stable architecture in a nanoconfined space, the ice arranges itself into a helix resembling a DNA-like structure," says Aarti Singh from Amity University and first author of the paper.

"This is the first report which mentions the existence of ice helix within hydrogel nanotubes," claims Prof. Mukherjee.

Sustained drug release

The researchers tested the hydrogel for sustained drug release. A drug loaded inside the hydrogel nanotubes will have sustained release at the target site as the helical architecture inside the nanotubes impedes burst release due

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to frictional drag. Nearly 90% of a drug (benzalkonium chloride) loaded in the hydrogel nanotubes was released over 22 hours.

Rapid diagnostic kit for chikungunya detection

An antigen-based chikungunya rapid diagnostic kit developed in 2013 by an international group of researchers was put to test in India, a dengue endemic country, to check its efficiency during co-infection with dengue. During the chikungunya outbreak that happened in Delhi in 2016, over 100 suspected chikungunya-dengue patients were tested using the new technology and the kit was able to detect chikungunya accurately — 93% sensitivity and 95% specificity.

The kit is designed to detect the chikungunya virus antigen in human serum. “Current tests for chikungunya look for the antibody produced by our body against the virus. This is the first time a technology has been developed to identify the virus antigen, and we are excited that it can perform well even in our country where the virus can be of different genotype,” explains Dr. Sujatha Sunil, from the Vector Borne Diseases Group at International Centre For Genetic Engineering And Biotechnology, New Delhi. She is one of the corresponding authors of the paper published in Virology Journal.

The ability of the antigen-based test to detect chikungunya at different times after the onset of fever was 72%, which is comparable with DNA-based test (76%) and far superior to the antibody-based test (48%). They also noticed that the detection rate of the kit remained high up to five days post-fever onset.

The kit was able to detect the antigen even in dengue co-infected patient and did not cross-react with dengue positive or chikungunya negative patients. The cross-reactivity was also tested with other fever-causing diseases like malaria, typhoid, hepatitis B and C and Salmonella infection. The new kit did not react with any of the samples.

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The kit is also faster than the DNA- and antibody-based methods and can give results in 15-30 minutes. “More validation with larger cohorts is necessary before bringing the kit into the market. As many rapid diagnostic kits have produced false positives and created panic, the government is extra careful about such kits. This is the first step to quick diagnosis which is important during an outbreak,” adds Dr. Sujatha.

The antigen-based diagnostic kit is also cost-effective. “Since we have collaborations with the Japanese team that created the kit, we now know the technology and the kit can be developed indigenously,” she says.

AIIMS team’s model can predict shock 12 hours in advance

Predicting shock (less blood and oxygen supply to major organs, which can lead to death) even 12 hours before it can be clinically recognised by doctors by using the current gold standard (intra-arterial blood pressure) is now possible, thanks to the work by an AIIMS-led multi-institutional team of researchers. Shock can arise from loss of blood volume, inefficient pumping by the heart or infection (sepsis).

Efficient algorithm

The machine-learning algorithm to detect shock at the time a single photo is taken using thermal imaging has an accuracy of 75%. The ability of the algorithm to forecast the probability of a shock happening three, six and 12 hours before clinical recognition can be done using the gold standard method is 77%, 69% and 69% respectively. The algorithm was used in conjunction with pulse rate to both detect and predict shock. The results were published in the journal Scientific Reports.

In paediatric intensive care units, 70-90% babies develop signs of sepsis. Almost 30% paediatric ICU patients suffer from sepsis shock and 30% of them end up dying due to multiorgan failure. “This number will be much higher at district hospitals. Sepsis shock is one major killer in paediatric ICUs,” says

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Dr. TavpriteshSethi from the Department of Paediatrics at AIIMS, New Delhi, who led the team. In principle, the model can be used for predicting shock in adult patients too. But the model has to be tested on adults as the current study was limited to 539 thermal images of paediatric patients.

It is possible to prevent organ failure and death by adopting simple measures such as fluid management through transfusion and raising the blood pressure using certain drugs. Body starts responding to shock very quickly but takes some time for clinical recognition. This is where the machine-learning algorithm comes handy in saving lives with its ability to detect and predict shock.

"Due to noise, thermal images are fuzzy and so it is difficult for the computer to identify body parts. So the machine-learning algorithm was trained to identify body parts, capture body surface temperature and calculate the temperature difference between abdomen and feet to detect and predict shock," says Aditya Nagori from Institute of Genomics and Integrative Biology and first author of the paper.

No human judgement

When there is less blood and oxygen supply, blood starts to flow away from the hand and feet to important organs such as heart and brain. As a result, the temperature of the limbs falls compared with chest and abdomen. "This temperature difference is not measured all the time even in an intensive care unit. And there is human judgement as well to call it a shock. But ours is a quantitative method without human judgement to measure the temperature difference between peripheral and centre of the body and predict shock," says Dr. Sethi. "Most importantly, ours is a non-contact, non-invasive method."

Just like temperature difference between peripheral and centre of the body, the pulse rate too increases when shock sets in. Pulse rate increases in response to reduced blood and oxygen supply. The heart beats faster to circulate smaller volume of blood causing higher pulse rate.

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Since the current study used a single image to detect and predict shock, images have to be taken at regular intervals for continuous monitoring. “We are expanding the scope of the work to use video for continuous monitoring,” Dr. Sethi says.

Since a single image along with pulse rate is all that is required for detecting and predicting shock, children admitted in ICUs at remote locations can be monitored using the model as a tele-diagnostic decision support system. “We are expanding the scope of the work to track patients remotely at the district level hospitals and primary heathcentres. We hope to start this before the end of the year,” he says. “Clinical use of the model in the safe ICU at AIIMS will start within the next six months.”

“The team is excited to launch a smartphone application which will incorporate the model capability to predict shock,” he adds.

The researchers were able to use the machine-learning algorithm to detect difference in body temperature at AIIMS once the ICU with big data warehousing, the first of its kind in India, started functioning since February 2016. “Here data of every patient in the paediatric ICU at AIIMS is captured every second,” Dr. Sethi says.

Diabetic drug improves the efficacy of two TB drugs

A protein essential for the formation of biofilm by TB-causing bacteria(Mycobacterium tuberculosis) has been finally identified by a multi-institutional team from Delhi’s Jamia Hamdard, National Institute of Pathology and Indian Institute of Technology (IIT) Delhi. Biofilm formed by TB bacteria acts as a physical barrier to drugs thereby protecting the microorganisms. The researchers also found two FDA-approved drugs used for treating diabetes and suppressing the immune responses were able to disrupt biofilm formation by the bacteria. When the existing drugs were used along with first-line anti-TB drugs, the dosage required to kill the bacteria was drastically

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reduced by over 50%. To validate the promising results obtained in the lab, the team has already initiated trials on mice.

Protein folding

The protein (peptidyl-prolyl isomerase-B or PpiB) belongs to a class of cyclophilins that facilitates protein folding. In other bacteria, the cyclophilin class of proteins is known to be involved in protein folding and biofilm formation. But its role in biofilm formation by TB bacteria was not known so far. Since bio-safety level 3 lab is required to work with TB bacteria, the researchers initially used the non-pathogenic M. smegmatis to understand the role of TB bacteria protein PpiB in biofilm formation. The researchers inserted the PpiB gene of TB bacteria into M. smegmatis and tested its ability to form biofilm.

" M. smegmatis bacteria generally produce less of biofilm in response to stress. But when we added the PpiB gene into M. smegmatis, the biofilm production was 1.5-fold higher," says Ashutosh Kumar from JH-Institute of Molecular Medicine, Jamia Hamdard, New Delhi and first author of a paper published in the journal npj Biofilms and Microbiomes. Dr. Kumar is currently at the Department of Microbiology at Tripura Central University.

Since drug development typically takes 10–15 years, the researchers turned to drug repurposing using FDA-approved drugs that can potentially bind to the PpiB protein and prevent biofilm formation by TB bacteria. Based on in silico analysis, researchers found two drugs — acarbose and cyclosporine-A — showed high binding capacity with the PpiB protein. So the two drugs can possibly inhibit PpiB protein and thereby prevent biofilm formation and make the bacteria vulnerable to anti-TB drugs. Gallium nanoparticles were also tested to study the ability of nanoparticles to bind and inhibit the protein and prevent biofilm production.

"We validated the binding property through in vitro studies. Both the drugs as well as gallium nanoparticles were able to bind very well with the purified form of PpiB protein," says Anwar Alam from the Kusuma School of Biological

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Sciences at IIT Delhi and another first author of the paper. Recombinant M. smegmatis expressing TB bacteria PpiB protein were cultured in the presence of FDA-approved drugs and gallium nanoparticles to check for biofilm formation. “There was reduced biofilm formation by recombinant M. smegmatis in the presence of the drugs and gallium nanoparticles,” Dr. Alam says.

The suppression of Ppib protein activity and inhibition of biofilm formation was more when higher dosages of the drugs and gallium nanoparticles were used. “Though the antidiabetic drug (acarbose) showed higher binding, there was increased biofilm formation when lower concentration was used. Further studies are needed to ascertain the correct acarbose concentration for inhibiting biofilm formation,” says Dr. Kumar.

Testing on TB bacteria

Based on the positive results using M. smegmatis, the researchers then tested the ability of the drugs to inhibit biofilm formation by TB-causing bacteria (Mycobacterium tuberculosis). “Both cyclosporine-A and gallium nanoparticles significantly reduced biofilm formation by TB bacteria. But acarbose had relatively lesser effect,” says Seyed E. Hasnain from the Jamia Hamdard Institute of Molecular Medicine and corresponding author of the paper. He is currently on deputation at the Kusuma School of Biological Sciences, IIT Delhi

The FDA approved drugs also increased the effectiveness of anti-TB drugs in killing TB bacteria. In the presence of anti-TB drugs and the FDA-approved drugs, the susceptibility of TB bacteria was higher. Isoniazid drug at 50% of the standard dosage was sufficient to kill TB bacteria. And 25% of the standard dosage of ethambutol killed TB bacteria. “Reduced dosage would mean less toxicity. And we presume that it can also shorten the duration of treatment, which can be ascertained only through trials,” says Prof. Hasnain.

Another significant finding is that the drug-binding sites within PpiB are the

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same in many pathogenic bacteria that form biofilm.

"Since PpiB is an essential protein, it can be targeted to inhibit biofilm formation across bacterial species. And as the drug-binding sites within Ppib is conserved across pathogenic bacteria, the protein can be targeted for disrupting biofilm production across human disease-causing microbial species," Prof. Hasnain says.

"One of the repurposed drugs can be possibly used to target latent mycobacterium," says Dr Nasreen Ehtesham from the ICMR-National Institute of Pathology and another corresponding author of the paper.

Rajasthan Zika strain is endemic to Asia, says new study

The Zika virus that infected 159 people in an outbreak in Rajasthan last year, could have been circulating in India for several years and is endemic to Asia, according to a new study published in the journal Infection, Genetics and Evolution this week.

The study, led by authors from Pune's National Institute of Virology (NIV), an institute under the Indian Council of Medical Research (ICMR), is the first to sequence full Zika virus genomes from India.

Confers herd immunity

"The finding that the outbreak was caused by an endemic virus is quite important," said Nathan Grubaugh, an epidemiologist from the Yale School of Public Health, who was not involved in the study.

"It suggests that people in the region may have been previously exposed to the virus, building herd immunity that may limit future outbreaks."

During the latter half of 2018, India recorded its first major Zika outbreaks in Rajasthan and Madhya Pradesh.

Around then, the ICMR said the Rajasthan virus had been sequenced and was closely related to a virus that had caused large epidemics and birth defects in Latin America in 2015.

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Then, in November 2018, the Ministry of Health and Family Welfare issued a press release, citing the NIV's research, to say that "known mutations" for foetal microcephaly were not present in the Rajasthan strain.

The Hindu has previously reported that the statement about "known mutations" was interpreted by MP's health authorities to mean that the Indian viral strain could not cause birth defects. The Ministry and ICMR were criticised for the misleading wording, but did not issue a clarification.

Crucial contradictions

This week's publication contradicts the ICMR's previous statements in two ways. First, it indicates that the Rajasthan Zika strain is not closely related to the Brazilian one.

"It appears that the Indian strain has been around for a while…The Brazilian strain diverged more recently," said Farah Ishtiaq, who studies the effects of infectious diseases on ecology at Bengaluru's Indian Institute of Science.

Prof. Grubaugh adds that the phylogenetic analysis in the paper, along with previous research, suggests that the virus has been in Asia for "at least 50 years".

"Based on limited data, I suspect it is [endemic to India]," he added.

While this is good news, because it implies that a portion of the population could be immune, it could also mean that Zika-related birth defects such as microcephaly were occurring even before the virus was first detected in India.

The NIV paper is also more cautious than the Ministry's press release on the implications of a mutation in the viral genome called S139N.

In a 2017 paper published in Science , the existence of this mutation in the Brazilian strain was linked, using animal data, with microcephaly.

Based on this paper, the Ministry press release had said the Rajasthan strain didn't have the "known mutation".

The current paper says: "A word of caution should be maintained on the claims

of these mutations on the development of microcephaly in humans, given no direct clinical evidence of their effect."

Emailed questions to Devendra T. Mourya, NIV Director and corresponding author of the paper, were not answered.

While endemicity means that large outbreaks, such as the Brazilian one, may not occur in India, serosurveys are needed to confirm this, said Prof. Grubaugh. In a serosurvey, a sample of the population is tested for Zika antibodies.

Drug-loaded microparticles to manage Parkinson's

Parkinson's disease, which affects the central nervous system of the body currently does not have an effective cure. The dopamine (neurotransmitter chemical) deficiency caused by the disease can, however, be overcome by providing drugs which are capable of crossing the blood–brain barrier.

But most of the time only 1% of the drug (levodopa) reaches the brain after being orally taken. Using dual drugs (levodopa with carbidopa) have increased the fraction of drug reaching the brain, but low half-life has posed challenges. Also, continuous intake of levodopa has in some cases caused serious side effects such as LID (Levodopa-induced dyskinesia).

Bioavailability

With a long list of problems staring at Parkinson's disease management, now researchers from Indian Institute of Technology, Delhi have tasted success. They have fabricated disc-shaped microparticles, merely 15 micrometres in size, made up of two compartments for carrying dual drugs without having drug–drug interactions.

The particles are made entirely of biodegradable and biocompatible polymers. "The polymers used are also FDA-approved and are currently in use as drug carriers. We tuned them according to our need. We made disc-shaped particles as they have a superior ability to attach to the intestinal lining, thereby

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increasing the bioavailability of the drug, crucial for oral drug delivery system" says Mr. Ashok Parthipan, first author of the paper published in Journal of Material Sciences. Ashok completed his M.Tech degree from the Department of Materials Science and Engineering (DSME) (formerly Centre for Polymer Science and Engineering), IIT Delhi. Disc-shaped bicompartmental particles made of mucoadhesive polymers can also prolong the gastric residence time which helps in providing sustained release of dual drugs in the gastrointestinal tract.

Efficiency tested

The drug release efficiency of the microparticles were tested using different medium. Two drugs, levodopa and carbidopa (4: 1 ratio), were incorporated inside the microparticles, one inside each compartment and studied.

The researchers simulated an environment similar to our digestive system and found that major release of the drugs took place in the stomach and intestine. The drugs get absorbed in the small intestine area and then travel via blood to the blood–brain barrier. Now, carbidopa acts as a helping hand and allows levedopa to cross the crucial barrier, reach the target zone in the brain and effectively manage the dopamine deficiency.

Also, more than 80% of the drug was released within five hours in the simulated gastric fluid, which is highly beneficial from a pharmacological point of view.

"Usually a person takes multiple pills a day to efficiently manage the symptoms of Parkinson's disease. This can be replaced by just one pill as these microparticles can deliver the required dose in a sustained manner and reduce the pill burden and side-effects for elderly patients who are more likely to forget their doses and face end of dose 'wearing-off' symptoms", explains Dr. SampaSaha, Assistant Professor, DMSE, IIT, Delhi corresponding author of the paper. "We are currently carrying out animal trials and the results look promising."

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Nilavembukudineer kills dengue virus, protects from chikungunya

Under in vitro conditions, nilavembukudineer (a Siddha medicine) was found to provide protection against chikungunya virus while it was effective as a treatment during acute phase of dengue infection. Dengue subtype-2, which is the most prevalent subtype in India, was used for testing the formulation. There was significant antiviral activity of the formulation at 3% of human dose onwards. Currently, there is no treatment for dengue and chikungunya.

The Tamil Nadu government had distributed nilavembukudineer concoction to treat people infected with dengue during the outbreak in late 2017.

Mode of action

A team of researchers led by Sujatha Sunil from the International Centre for Genetic Engineering and Biotechnology (ICGEB), Delhi found that thenilavembukudineer formulation was modulating the host response in the case of both chikungunya and dengue virus but in a different manner. The mode of action of the concoction is antiviral in the case of dengue while immuno-modulatory in chikungunya infection. “The reason why we say the formulation is immuno-modulatory is because of the way nilavembukudineer acts upon viral infections in different types of cells,” says Dr. Sunil. However, the mode of action of the formulation on immuno-modulation is yet to be understood.

To study the antiviral activity, the researchers tested the formulation on monocytes and macrophages in the case of dengue and epithelial kidney cells for chikungunya virus. “The monocytes and macrophages are the primary sites of infection in the case of dengue. And kidney is the secondary site of infection by chikungunya virus,” says Jaspreet Jain from the vector Borne Diseases Group at ICGEB and first author of a paper published in the Journal of Ayurveda and Integrative Medicine . The primary site of infection of chikungunya virus is fibroblasts before the virus enters the blood stream and then to different organs.

“The joints are the worst affected due to chikungunya virus infection. But we

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don't have primary joint cell lines to test the formulation at this point," says Dr. Sunil.

Safety studies

Safety studies showed that nilavembukudineer concoction was non-toxic starting from 3% (about 1.8 milligram per millilitre) of human dose. However, the researchers found that andrographis, which is the active ingredient ofnila vembukudineer, when used alone was extremely toxic at 3% of human dose. Human dose is prepared by mixing 5 grams of nilavembukudineer in 240 ml of water. It is then boiled and reduced to 30 ml and consumed.

"This shows that nilavembukudineer as a formulation is safe for use in humans," Dr. Sunil says. "The cytotoxicity of andrographis reduces drastically when given as a concoction with other ingredients of nilavembukudineer ." The nilavembukudineer herbal concoction is made by mixing nine ingredients in equal measure.

"The importance of herbal medicines lies in the fact that they use plant as a whole. This is important because if the modern concepts are used in alternative medicine and only active component is separated, then it will cease to act as a herbal medicine and will plainly act as a chemical drug which can be highly toxic/hazardous to the human body," the paper notes.

"Based on the results of our study we see the formulation working well for dengue and chikungunya infections especially during outbreak conditions," she says.

Based on the positive results from in vitro studies, the researchers are in the process of studying the safety and mode of action of the formulation using mice models.

How rocking the bed promotes deep sleep and improves memory

SojaRajakumari,sojaa was a beautiful lullaby sung by K. L. Saigal; M.L Vasanthakumari has sung a series of lullabies in Tamil. Both are available

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on the Web. Lullabies are slow, gentle and accompany the rocking speed of the cradle in which the baby is placed. Most families invariably have a cradle, be it made of sandalwood and swung by silk ropes (chandan ka palna, reshamkidori, sung by Hemant Kumar) or a poor mother's make-do one using a saree hung from a tree — it is the rocking that puts the baby to sleep. The lullaby is to soothe the baby's mood. That music soothes the brain is known and is being understood in neurobiological terms (e.g., Chanda and Levitin, 'The neurochemistry of music',Trends in Cognitive Sciences, April 2013). Thus, in the cradle the music is a bonus.

That rocking is sleep-inducing even in adults, particularly senior citizens who sit in a rocking chair trying to read a book after lunch. What is it about rocking that promotes sleep? This question is being answered recently by a Swiss neurobiology group. They have published two papers in the January 2019 issue of Current Biology (http://doi.org/10.1016/j.cub.2018.12.007, and also https://doi.org/10.1016/j.cub.2018.12.028). The group decided to recruit 18 young adults as volunteers, put in small metal electrode discs on their scalps and recorded the activity of their brains using a computer device called an electroencephalogram or EEG. Each volunteer was put on a bed, and the bed was rocking rhythmically the whole night at a slow speed for 8 hours. For comparison, they were again asked to sleep later on the same beds, but this time with no rocking and their EEG recorded. All other conditions of the environment were the same, so that they could study the effect of rocking on the sensory processing of the brain. Comparison of the brain waves revealed that rocking promoted the volunteers falling asleep sooner, sleep more deeply and wake up less frequently.

Stages of sleep

Sleep in humans occurs in two different steps. During sleep, our eyes actually move even when closed. One phase is when the eyes more rapidly (referred

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to as rapid eye movement or REM sleep) and the other where REM does not occur or NREM. Most dreams occur during REM sleep and it is thought to play a role in memory, mood and learning. During rocking, the EEG pattern showed slow oscillations. Rocking allowed the brain to slowly fall in synchrony with the rocking stimulation and speed, thus entraining the brain and promoting deep NERM sleep.

How does this entrainment or synchrony occur? The brain has a central part called the thalamo-cortical network. This is a system of neural fibres that pass on electrical signals in the brain connecting the thalamus and the cortex regions and integrates the sensory information into so that the brain "feels"; it also plays a role in memory.

Does rocking during sleep affect memory? It does seem to help. In order to test this, the group gave the volunteers a simple test of pairing two words appropriately. The test was given after they had a night's sleep in the rocking bed and again after they slept on the same bed which was not allowed to rock. The volunteers did better in the morning test when they were rocked! Thus the group concludes that rocking boosts deep sleep, sleep maintenance and memory in healthy sleepers. How does this translate to rocking babies in cradles? Or should one test a set of volunteer senior citizens napping on a rocking chair post-lunch, and again when they nap when the chair does not rock? Interesting!

When you rock

The group wanted to know whether rocking promotes sleep in other mammals too. They decided to use mice as experimental animals. They placed electrodes on their heads and monitored the EEG (and also electromyograph patterns or EMG, which record how the skeletal muscles are affected) signals while the mice were sleeping in rocking cages and in stationary cages. Mice needed a faster rocking rate than us humans, but otherwise behaved the same way as humans do.

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It has been believed that the effects of rocking are mediated through the vestibular system in the head. The vestibular system starts from the inner ear and goes to the central part of the brain. It is what helps us keeping balance while walking, feel the movement of an elevator going up or down, and lose balance just upon hearing a deafening noise (as on hearing Deepavali crackers). The role of the vestibular system in the mouse experiments become clear when the scientists tried the experiments using mice that have vestibular deficiency; these animals were insensitive to rocking. Based on these experiments with mice and men, the authors extrapolate to how they may be relevant to people with insomnia, mood disorder and memory impairment. They suggest that it might help such people, and even ageing populations, if they use rocking chairs while napping, and if possible, try and obtain a gently rocking bed.

If lullaby soothes the baby, should senior citizens too have any kind of soothing tunes as they nap? One site — sleepadsvisor.org — suggests a list of best relaxing music for sleeping, and that listening to music that has relaxing tones is best. Classical music pieces that have repeating slow tempo and no high notes are good, and meditation music and nature sounds are excellent. The group named Indian Meditation Music gives several examples, most of them with flute as the basic instrument. Another site called Yellow Brick Cinema offers “Relaxing Piano Music 24/7”. And the Youtube also offers “Raag Hansdhwani-Relaxation Music Therapy” and a whole hour of “Tampura Key D1 hour for Hindustani and Carnatic Relaxation Music”. Take your pick, relax and enjoy a nap!

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67% cancer patients in SE Asia die before 70: WHO

In 2018, 18.1 million new cases of cancer developed worldwide; 9.6 million people died from the disease; 70% of the deaths occurred in low and middle-income countries, including those of the World Health Organisation (WHO)

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Southeast Asia region; and 67% of the region's cancer patients died before the age of 70. The figures were released by the WHO Southeast Asia here on World Cancer Day.

Dr. Poonam Khetrapal Singh, WHO Regional Director for South-East Asia, said: "Cancer is far from an equal-opportunity killer. Inadequate access to cancer screening, diagnosis and treatment is the primary cause of deaths."

She explained that, in 2017, just 30% of low-income countries reported having cancer treatment services available.

Just 26% of low-income countries meanwhile reported having pathology services generally available in the public sector, leading to late diagnosis and a lower chance of successful treatment.

According to figures for India released by the National Institute of Cancer Prevention and Research (NICPR), one woman dies of cervical cancer every eight minutes in India; for every two women newly diagnosed with breast cancer, one woman dies of it in India; as many as 2,500 persons die every day due to tobacco-related diseases; and tobacco (smoked and smokeless) use accounted for 3,17,928 deaths in men and women in 2018.

As new cases rise, leprosy in spotlight

The Centre says a more aggressive detection campaign is being carried out, explaining the numbers.

The Leprosy Case Detection Campaign has shown that 34,730 cases were detected in 2016, 32,147 in 2017, and 16,097 in 2018. "We welcome the rise. It means we are catching these cases and putting the patients on treatment. But what the department is looking at is the new cases detected the existing cases with leprosy-related handicap, and new cases in children. They are our actual ground check. The three parameters have shown a downward trend," said Anil Kumar, Deputy Director-General (Leprosy), Union Health Ministry.

Moreover, he clarified, "The figures don't tell us the actual story," adding that

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that India's leprosy management programme is running in a very aggressive sweep mode, after the "relaxed period" of 2005.

The number of cases reported fell after 2005-06, when India was declared leprosy-free — the prevalence rate at the time was 0.84%. "It was only at the end of 2011 that we realised leprosy is very much around — when people started reporting in with leprosy-related disabilities — and we refreshed our strategy to find and treat new cases," Dr. Kumar said.

Disease management efforts now include going down to the village level in what is called the "active seeking mode" for cases, where health workers go from house to house and physically examine people for a leprosy patch. "We were earlier missing many cases because people weren't reporting due to fear, social stigma and lack of awareness," said Dr. Kumar.

Leprosy is a chronic disease caused by a bacillus, Mycobacterium leprae, which multiplies slowly. The incubation period of the disease, on average, is five years. In some cases, symptoms may occur within one year but can also take as long as 20 years to occur. "This is exactly the trouble with the elimination of leprosy. The long incubation period, and the social stigma attached to it, makes it a tough disease to eliminate," said Dr. Kumar.

Leprosy mainly affects the skin, the peripheral nerves, mucosa of the upper respiratory tract, and also the eyes. The disease is transmitted via droplets, from the nose and mouth, during close and frequent contacts with untreated cases. Untreated leprosy can cause progressive and permanent damage to the skin, nerves, limbs and eyes. It is curable with multi-drug therapy (MDT).

There has been a change in the percentage of new child cases from 9.49% in 2013-14 to 8.15% in 2017-18, with the level having remained almost stagnant at 8.94% in 2015-16 and 8.69 % in 2016-17. "Our special emphasis is on children, for whom we have brought in active detection intervention, with primary health workers educating them from the school-level onward. We are

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working at developing a positive attitude towards detection and treatment," said Dr. Kumar.

IIT Madras identifies unique pathways of eye cancer

Based on computational modelling, researchers at the Indian Institute of Technology (IIT) Madras have identified the biochemical pathways that eye cancer (retinoblastoma) preferentially chooses for growth and survival. The pathways chosen are very different from the ones that normal, healthy cells choose.

Retinoblastoma is a childhood tumour, affecting single or both the eyes. Retinoblastoma-related mortality rate is high in Asian and African countries due to its late stage presentation. The current treatment methods — chemotherapy and enucleation — are associated with severe disabilities. Therefore, a systems level understanding of the disease is necessary for suggesting alternative treatment and novel diagnostics.

As a first step, the researchers used tumour samples taken from seven retinoblastoma patients and three normal retina samples. Unlike cell lines, actual patient samples were used and so even fewer samples would suffice for the modelling. The RNA sequence was extracted from the tumour and normal samples as a first step to derive the model.

Biochemical pathway

RNA translates into proteins (enzymes) and the enzymes catalyse the reactions which form part of different pathways. These components are exploited to generate respective data types — RNA sequence data, proteomics data and metabolomics data — each of which can be integrated to derive the model.

For this study, the RNA sequence data and physiological/biochemical information were used to derive patient- and healthy cell-specific models. The subsequent models were then used to analyse the biochemical pathways.

"This way we were able to differentiate the biochemical pathways that cancer

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cells preferentially choose for their survival," says Dr. Swagatika Sahoo, a INSPIRE faculty at the Department of Chemical Engineering, IIT Madras who co-led the team. Theresults of the studywere published in the journal FEBS Letters .

For instance, unlike health cells which use carbohydrate for energy and survival, the tumour tissue preferentially uses four amino acids instead.

"Amino acids are a major source of energy for the tumour tissue, while carbohydrate and fatty acids are used to a lesser extend for energy," says Dr. Sahoo.

By relying on amino acids for energy, the tumour tissue preserves the fatty acid for other important functions such as signalling and membrane structure.

While amino acids are used at a higher rate, cholesterol synthesis is under-utilised by the retinoblastoma tissue. "The reason why the tumourunder-utilises cholesterol synthesis is to preserve the redox potential of the cells, thereby mask the diseased condition. Any change in the redox potential is seen as abnormal and can alert the stress pathways," says Dr. Sahoo.

Different subtypes

Unlike normal cells, the tumour tissue specifically synthesised only long and very long chain fatty acids, which play a major role in signalling.

The researchers were also able know the different subtypes of retinoblastoma based on RNA sequence data extracted from the patients. "The disease subtypes arise because the tumour tissue chooses to synthesise specific fatty acids — long or very long chain fatty acids — for its survival," Dr. Sahoo says. "The disease subtypes are well known and our model was able to correctly and fully capture this information."

The researchers compared the metabolism of diseased and health tissue and zeroed in on proteins critical for cancer cells but not the normal cells.

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"Based on modelling, we identified 13 drug targets that can be used for treating eye cancer. Eight of the 13 targets are already known and drugs that have already been approved for other cancer types are specific to the eight targets. The remaining five are novel drug targets," says Dr. Karthik Raman from the Department of Biotechnology at IIT Madras and a co-author of the paper.

Big win for Piramal as SC lifts ban on Saridon

The Supreme Court has ruled in favour of Saridon, a heritage brand from the healthcare product portfolio of Piramal Enterprises Ltd. (PEL), exempting its formulation from the list of banned FDCs (fixed dose combinations).

In September 2018, Piramal had obtained a stay order from the Supreme Court on the ban, which allowed it to continue manufacturing, distribution and sale of the fixed dose combination.

Commenting on the Supreme Court ruling, Nandini Piramal, executive director, Piramal Enterprises Ltd., said, "We are pleased with the Supreme Court ruling, as it is an affirmation to our commitment to provide effective and safe healthcare solutions that address unique needs of Indian consumers. We were confident that the law would prevail in our favour. Saridon is a heritage brand trusted by customers for the last 50 years in India," she added.

Saridon is a Rs. 100-crore brand, and it is so popular that it is estimated that 31 tablets are sold every second in India.

WHO, Ministry conclave on yoga benchmark

The Ministry of AYUSH and World Health Organisation (WHO) are jointly organising a three-day conclave for reviewing the WHO document "Benchmarks for Training in Yoga" beginning Tuesday.

WHO is developing the yoga document as part of its global strategy to strengthen the quality, safety and efficacy of traditional and complementary

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medicine.

The development of this benchmark document is included in the project collaboration agreement signed between WHO and Ministry of AYUSH on cooperation in the field of traditional and complementary medicine under WHO strategy covering the period 2014-2023.

"A total of 16 yoga experts would be reviewing the draft document. Out of 16 experts, 11 international experts are from USA, UK, Canada, Brazil, Saudi Arabia, Sri Lanka, Thailand, Japan, Australia and Malaysia. There would be four session on all three days. All the technical sessions would be coordinated by the experts from WHO Secretariat," noted a release issued by the AYUSH Ministry.

This benchmarks document will be used in evaluating Yoga therapy, identifying trends in utilization, developing payment structures for service models, establishing regulatory framework for Yoga practice, the release said.

Centre brings 42 non-scheduled cancer drugs under price control

The government said it had brought 42 non-scheduled anti-cancer drugs under price control, capping trade margin at 30%, which would reduce their retail prices by up to 85%.

The National Pharmaceutical Pricing Authority (NPPA) has invoked extraordinary powers in public interest, under Para 19 of the Drugs (Prices Control) Order, 2013 to bring 42 non-scheduled anti-cancer drugs under price control through trade margin rationalisation, an official release said.

"Invoking paragraph 19 of DPCO, 2013, the government hereby puts a cap on trade margin of 30% and directs manufacturers to fix their retail price based on price at first point of sale of product... of the non-scheduled formulations containing any of the 42 drugs," the Department of Pharmaceuticals (DOP)

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said in a notification.

105 brands

As per data available with NPPA, the MRP for 105 brands will be reduced up to 85%, entailing minimum savings of Rs. 105 crore to consumers, it added. Currently, 57 anti-cancer drugs are under price control as scheduled formulations. Now, 42 non-scheduled anti-cancer medicines have been selected for price regulation by restricting trade margin on the selling price (MRP) up to 30%, the notification said.

"These would cover 72 formulations and 355 brands as per data available with NPPA. More data is being collected from hospitals and manufacturers to finalise the list," it added.

The drug manufacturers have been given seven days to recalculate the prices and inform the NPPA, state drug controllers, stockists and retailers, it said. The revised prices shall come into effect from March, 8, it added.

The NPPA currently fixes prices of drugs placed in the National List of Essential Medicines (NLEM) under Schedule-I of the DPCO. So far, around 1,000 drugs have been brought under price control under the initiative.

Non-scheduled drugs are allowed an increase of up to 10% in prices every year, which is monitored by the NPPA.

Prices slashed for 463 cancer medicines

The National Pharmaceutical Pricing Authority (NPPA) has reduced the maximum retail price of 463 non-scheduled cancer medicines.

The memorandum revising the prices downwards was issued by NPPA's director (pricing) Amarpal Singh Sawhney on March 11.

As per the memorandum, manufacturers and hospitals have been directed to convey the revised MRP, to be effective immediately based on the trade margin formula.

The NPPA has issued the list of the 463 non-scheduled anti-cancer

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drugs whose prices have been drastically reduced through trade margin rationalisation.

Glenmark gets USFDA nod for generic version of acne treatment gel

Glenmark Pharmaceuticals said it had received the final approval from the U.S. health regulator for its generic version of BenzaClin gel used in treatment of acne. The approval granted to Glenmark Pharmaceuticals Inc., USA (Glenmark) by the United States Food & Drug Administration (USFDA) is for Clindamycin and Benzoyl Peroxide Gel, 1% |5%, a generic version of BenzaClin1 Gel, 1% |5% of Valeant Bermuda, the firm said.

Too much vitamin D may cloud benefits

According to a recent study, in the U.S., obese older women, who take more than three times the recommended daily dose of vitamin D showed improvements in memory and learning but also had slower reaction times. The researchers hypothesised that slower reaction times may increase the risk of falling among older people.

The results of the study were published in Journals of Gerontology: Series A. The researchers used computers to assess the impact of vitamin D on cognitive function. They evaluated three groups of women between 50 and 70 years in a randomised controlled trial. One group took the recommended daily dose of 15 mcg of vitamin D each day for a year. Another group took more than three times and the third took nearly seven times.

The researchers found that memory and learning improved in the second group but not in the group that took the higher dosage. Meanwhile, the women's reaction time showed a trend to be slower as dosage increased. "The slower reaction time may have other negative outcomes such as potentially increasing the risk of falling and fractures," said senior study author Sue

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Shapses.

IIT Guwahati's bone graft aids extensive bone formation

A scaffold made of silk–bone cement composite doped with silicon and zinc metal ions has been found to regenerate new bone tissue in rabbits in three months. The newly formed bone forms a seamless joint with the existing bone and has blood vessels inside it. Tests carried out on rabbits with defective thigh bone (femur) showed extensive bone formation of 73% at the end of 90 days compared with 49% in the case of scaffold made only of silk fibre. Even at the end of 30 days, there was adequate bone regeneration and new blood vessel formation.

Superior graft

The bone graft fabricated and tested by researchers at the Indian Institute of Technology (IIT) Guwahati is superior to currently available ones, affordable and does not require external use of growth factors for bone cells to grow.

"At the end of three months, the silk fibre had completely degraded leaving behind a homogeneous bone produced by rabbit bone cells. The newly formed bone had healed the defective femur," says Prof. Biman Mandal from the Department of Biosciences and Bioengineering, IIT Guwahati who led the team. The bone cement made of calcium phosphate becomes a part of the bone while the biocompatible metal ions (silicon and zinc) get leached out at the end of 90 days.

The team is now validating the bone graft in large animals for clinical translation.

The scaffold is fabricated by first doping the bone cement with silicon and zinc and mixing the bone cement with chopped mulberry silk fibre. The bone cement gets adsorbed on the silk fibre. Liquid silk fibre is then added to bind the chopped fibre and bone cement; the liquid silk also makes the composite

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highly porous. The silk–bone cement composite has higher density and strength, more surface area and high surface roughness, closely resembling a native bone.

"The zinc and silicon ions get leached from the composite and activate bone and blood vessel cells. This leads to faster regeneration of the bone tissue and blood vessel formation," says Prof. Mandal. "By doping with these metal ions we are doing away with external addition of growth factor and also making the graft affordable."

"While the silk scaffold provides the physical cues, the silicon and zinc metal ions provide the chemical cues. These two synergistically mimic the biological cues which people use for tissue engineering," explains Joseph Christakiran Moses from the Department of Biosciences and Bioengineering, IIT Guwahati and first author of a paper published in the journal ACS Biomaterials Science & Engineering.

Explaining how new blood vessels are formed, Moses says: "Silicon and zinc trigger a molecular response within the bone cells which makes them feel that they are lacking oxygen (triggering hypoxia response element). So the bone cells start secreting pro-blood vessel forming (angiogenic) signals leading to vascularisation."

Bone regeneration

The compressive strength of silk fibre is about 40 kPa, while it is nearly double in the case of the silk–bone cement composite. Though doping with the silicon and zinc metal ions reduces the mechanical properties, particularly the compressive strength, the bulk strength of the doped composite is sufficient to activate bone regeneration.

Through in vitro studies carried out prior to experimentation with rabbits, the researchers realised that incorporation of bone cement and metal ion doped bone cement enhanced the bone tissue regeneration capacity.

While the composite was seeded with bone cells for in vitro studies, in

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rabbits, the composite was used without adding any bone cells. “Bone cells from neighbouring tissue migrate and bind to the scaffold and aid in bone regeneration,” Prof. Mandal says. The high porosity allows the bone cells to migrate and occupy the insides of the composite and regenerate the tissue, while the surface roughness of the composite, which closely mimics the native bone, facilitates faster and better regeneration of the bone.

End stigma and discrimination to end TB

It was April 2017 and 30 tuberculosis (TB) survivors were participating in a lively group exercise at a workshop in New Delhi. They were identifying barriers that people with TB — like themselves — commonly faced in accessing health information and services. Each TB survivor brought his/her own personal experience to the discussion — the difficulties in getting a clear diagnosis, doctor-shopping, the lack of information on what the treatment involved, having to deal with side-effects, the loss of income, to name a few. While TB had impacted each of their lives differently, they were all unanimous in identifying one cross-cutting barrier — stigma and its assiduous companion, discrimination.

In the two years since, the team at REACH, an organisation working on TB since 1998, has witnessed similar scenes play out at other workshops around the country. Over 300 TB survivors from across India — all of whom attended trainings to help them become powerful TB champions and advocates — described stigma as an impenetrable barrier in accessing TB services.

Landmark years

In many ways, TB has never been more visible than before. The years 2018 and 2019 have been landmark years in the fight against TB, globally and in India, with the first ever High Level Meeting on TB held at the United Nations last year. In India, there is high political will and commitment to end TB, budgets are slowly increasing, new social support schemes have been

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announced and TB survivors are speaking up. There is a lot of talk of 'ending TB' and the ambitious phrase — TB elimination — has entered our lexicon. But as yet another World TB Day comes around on 24 March, it is important to keep reminding ourselves that we cannot win the fight against TB without ending stigma and discrimination. And we cannot end stigma and discrimination if we do not improve public understanding of TB — that it is curable, that pulmonary or lung TB spreads through air, that a person with TB becomes non-infectious soon after starting treatment and that extra-pulmonary TB (TB that affects parts of the body other than the lungs) is not infectious. Even as the government steps up investment in new tools and strengthens service delivery systems, we must make sure that stigma and discrimination are not left out of global, national and local plans to end TB.

Impact of stigma

The impact of stigma extends beyond the shame, fear and guilt that a person with TB can feel. As many TB survivors have told us over the years, stigma is often self-directed and internalised, drawing on social misconceptions of TB. This is especially true of women with TB, who bear the brunt of criticism from their families and whose biggest fear is of infecting their children. TB is a curable disease yet the impact of stigma can be long-lasting, often resulting in the breakdown of relationships. Stigma can be more devastating than the disease itself.

From the health system's perspective, stigma is a powerful deterrent at every step along the care cascade — the pathway from when someone develops symptoms of TB to until after they are declared cured. Stigma can prevent someone with symptoms of TB from accessing services — we have seen that the fear of being diagnosed with TB often outweighs the anxiety associated with feeling ill or in poor health. Stigma and discrimination also come together to inhibit someone with TB from continuing their treatment or

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seeking preventive therapy for their family.

Last year, REACH initiated the first ever Legal Environment Assessment of TB in India, an exhaustive exercise to understand how TB interacts with the law and with human rights. Survivors of TB and their family members interviewed for the LEA brought up the overt and covert ways in which stigma and discrimination play out — young women thrown out of their homes by husbands and families, children with TB physically isolated in school or prevented from sitting in the classroom, subtle ostracisation by co-workers at the workplace and discrimination by healthcare workers at health facilities in both the public and private sectors, among others.

As the LEA report recommends, adopting a rights-based, community-led, gender-sensitive and person-centred approach is central to reducing stigma and discrimination. This means ensuring that all persons with TB receive respectful and high-quality treatment, including adequate information about TB and counselling. For this, we need to sensitise healthcare providers to issues faced by those with TB and ensure they act in a non-discriminatory manner. We must provide both treatment and legal literacy to people with TB, so that they understand their rights and can speak up if these are violated.

Champions

Most of all, we must continue to empower and centre-stage TB survivors and champions to speak up boldly about their TB stories. Like Arti and Jagannath, for instance, who were both battling TB for over five years, running from one doctor to another and struggling to raise their young children. They were also dealing with fraught relationships and with the social shaming and isolation by their respective families. Today, they are both proud to be TB champions, at the forefront of the response to TB in their communities. As Arti says, for the people in her area, she's now 'TB-wali madam', and it's a label she is proud of.

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As more champions like Arti and Jagannath speak up, we must develop a robust system to ensure that they not only have a seat at the table but also have a say in decision-making that impacts the everyday lives of those living with TB. It is the active involvement of these TB survivors and champions that can give an impetus to our collective efforts to improve public understanding of TB, reduce stigma, prevent discrimination and end TB in India.

Govt. notifies new rules for drugs, clinical trials

The Union Health Ministry has notified the Drugs and Clinical Trials Rules, 2019, with the government stating that the move is aimed at promoting clinical research in the country.

The rules will apply to all new drugs, investigational new drugs for human use, clinical trials, bio-equivalence studies and ethics committees.

Time reduction

The highlights of the notification include reduction in time for approving applications, which has now come down to 30 days for drugs manufactured in India and 90 days for those developed outside the country. “Also, in case of no communication from Drugs Controller General of India, the application will be deemed to have been approved,” the notification said.

As per the new rule, the requirement of a local clinical trial may be waived for approval of a new drug if it is approved and marketed in any of the countries (EU, U.K., Australia, Japan and U.S.) specified by the Drugs Controller General with the approval of the government.

“The new rules will ensure patient safety and an ethics committee will monitor the trials and decide on the amount of compensation in cases of adverse events,” the Ministry said.

Biotechnology

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Molecular mechanism of prostate cancer subtype unravelled

The molecular mechanism and pathobiology of SPINK1-positive prostate cancer subtype, the second most recurrent and aggressive in nature, that affects about 15% of patients has been finally unravelled. The study was done by a multi-institutional team led by Prof. Bushra Ateeq from the Department of Biological Sciences and Bioengineering at Indian Institute of Technology (IIT) Kanpur. The SPINK1-positive prostate cancer subtype derives its name from the excess amount of SPINK1 oncogene found in the cancer cells.

Excess production of SPINK1 gene responsible for tumour and metastasis is not restricted to prostate cancer alone but also seen in colorectal, lung, pancreatic, breast and ovarian cancers. The insights gained in this study might therefore help in the treatment and disease management of several SPINK1-positive malignancies.

In addition to excess amount of the SPINK1 oncogene, the researchers found that most cancer cells belonging to this subtype also have more than normal amount of a particular protein called EZH2. Also, the levels of two microRNAs (miRNA-338-5p and miRNA-421) produced in SPINK1-positive cancer cells were much less.

“We found that the increased levels of EZH2 protein triggers the reduction in the synthesis of these two microRNAs in SPINK1-positive cancers. And the reduced levels of the two microRNAs in turn lead to over production of SPINK1,” says Prof. Ateeq. “The EZH2 protein sits on the regulatory region of the two microRNAs and shuts down their synthesis leading to excess production of SPINK1.”

Findiings corroborated

The researchers first discovered excess levels of SPINK1 protein and reduced amount of the two microRNAs on analysing the global data sets of

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prostate cancer patients. These findings were then corroborated in SPINK1-positive prostate cancer cell lines.

To validate the role of the two microRNAs in regulating the expression of the SPINK1 oncogene, the researchers introduced the microRNAs into the SPINK1-positive cancer cell lines. When the amount of microRNAs in the cell lines was increased, the SPINK1 level reduced and there were marked changes in the oncogenic properties — the cell proliferation and invasion reduced.

"The observations made using SPINK1-positive cell lines were validated in chicken embryos and mouse models," says Anjali Yadav from the Department of Biological Sciences and Bioengineering at IIT Kanpur and one of the first authors of a paper published in Clinical Cancer Research.

In both chicken embryo and mouse model experiments, the SPINK1-positive prostate cancer cells were modified by introducing the microRNAs and were tested for tumour growth and metastasis. "Tumour was found growing aggressively in mice of the control group but significantly reduced in size in the microRNA overexpressing group," says Vipul Bhatia from IIT Kanpur and the other first author of the paper. "A significant reduction in tumour growth was also observed in chicken embryos that were implanted with microRNA-modified prostate cancer cells."

Metastasis was also significantly reduced in both the lungs and bone marrow of mice implanted with microRNA-modified prostate cancer cells. But metastasis results were a little different in the case of chicken. While metastasis was less in the lungs, but both control and microRNA modified cancer cells failed to metastasise in the liver.

The researchers tested the effectiveness of epigenetic drugs to restore the levels of the microRNAs and reduce the expression of the SPINK1 gene using SPINK1-positive cancer cell lines that did not have the two microRNAs.

"These drugs could restore the expression of the two microRNAs leading to a

reduction in the SPINK1 expression. We could abrogate the SPINK1-mediated oncogenicity in terms of cell-cycle progression, stemness and drug resistance," says Prof. Ateeq. "We could see similar effects when we replenished the SPINK1-positive cancer cell lines with synthetic microRNAs."

"We will soon start studying the role of other RNA species which don't code for proteins but play an important role in SPINK1 gene regulation. We are also looking at other genetic aberrations that play an oncogenic role in the SPINK1-positive subtype," says Prof. Ateeq.

Carbon microneedles: Low-cost, painless injections

Tiny needles less than 1 mm in size have been developed by researchers from Indian Institute of Technology (IIT) Kharagpur. When arranged on a patch, the tiny hollow microneedles can be used for painless drug delivery.

Last year, the team had developed microneedles from a widely used photosensitive polymer (SU-8). Since the needles were not hard enough and biocompatible, they modified it using a simple process of extreme heating or pyrolysis. This produced glassy carbon needles which were almost 300 times stronger than the original ones. Since it was made of carbon it was also biocompatible.

Heating removed most of the nitrogen and oxygen in the polymer and the needle were solely made of carbon. The needles showed no toxicity when tested on mice models, says Prof. BidhanPramanick who completed his post-doctoral research from the institute. He is one of the corresponding authors of the work published in Nature Microsystems & Nanoengineering.

The needles were arranged in a patch (10 X10) and tested for drug delivery. The patch was attached to a 5 ml syringe and flow rate studied. They found the flow corresponds to the inlet pressure suggesting that drug delivery can be controlled by managing the pressure.

Drug delivery

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"We are now working on developing a drug reservoir and micropump which can be attached to the patch for controlled drug delivery. Just like a band-aid, we can fabricate a dia-aid that can be used by diabetic patients for painless insulin administration," says TarunKanti Bhattacharyya from the Department of Electronics and Electrical Communication Engineering at the Institute and one of the corresponding authors of the work. "Though we cannot bring down the cost of insulin, this patch can reduce the device cost by almost 50%."

When a needle is inserted into the skin, it experiences resistance from the skin. A good needle should be able to overcome the forces to penetrate the skin. Using compression and bending tests, the researchers found that the needles did not break or bend when force was applied. The patch was tested on mouse models and even after 15 insertions, the patch and needles remained intact. "We found that the new carbon microneedles overcame the resistive forces of our skin and was able to successfully pierce the skin. And as the needles are only 400 micrometer long, it will be completely painless," says Richa Mishra, PhD scholar at the institute and first author of the work.

BIO-TECHNOLOGY

Detecting ultralow levels of mercury in water

Mercury levels in water need to be checked carefully as it is a toxic substance that contaminates the food chain. A team at Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, has found an innovative way to develop a sensor that operates using Surface Enhanced Raman Spectroscopy and has high sensitivity (60 X 10-18 M which is 0.01 parts per quadrillion), far better than other methods of detecting mercury in water.

Mercury is a heavy metal that is predominant in the environment. It mixes with the environment due to both natural (e.g. volcanic activity) and anthropogenic (e.g. electrical appliances such as mercury lamps) activity. Studies have shown that industrial effluents can have higher mercury levels than that allowed by the WHO and Indian guidelines. With allowed levels of mercury in

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drinking water and effluents being in the range of 1–10 microgram per litre, it becomes necessary to develop sensors that can measure mercury levels in water with high sensitivity and selectivity.

The small molecule — histidine conjugated perylene diimide (HPH) —when dissolved in water shows green fluorescence under laser light. When water contaminated with mercury is added to this solution, the fluorescence is absent, and the molecules form a hydrogel. This method can detect only up to 5 nanomolar (0.1 parts per billion) of mercury in water. However, the sensitivity drastically improves with a novel technique developed by T. Govindaraju's group in collaboration with that of Suresh Bhargava of RMIT, Australia.

Sensitive detector

The small HPH molecules are organised on gold thin films coated on polystyrene beads. "The small molecule is a bolamphiphile, because it has both hydrophilic (histidine) units on the surface and hydrophobic (perylene) core units," explains Dr Govindaraju in whose lab the technique was developed. The molecule has two arm-like projections on either side of the core, one of which binds to the gold surface and the other is free pointing outwards. When mercury contaminated water is added to this mixture, the mercury ions bind to the free ends. When subjected to Raman spectroscopy, the response after mercury has bound to the particles is highly enhanced as compared to before the binding of mercury. This gives a measurable optical response. "Our system is capable of detecting attomolar [concentration], it can detect any concentration above this level with very high accuracy," says Dr Govindaraju. Although the technique has been demonstrated for water, it can come in useful for detecting mercury elsewhere too. "This technique can be used for any other sample, including biofluids or tissue extracts, wherein detection of such low concentration does matter," he adds.

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inStem scientists' research can prevent, treat colitis

Researchers have successfully isolated a microbial metabolite (Urolithin A or UroA) responsible for protecting the integrity of the gut lining. Leakage of toxins and bacteria leading to inflammatory bowel diseases such as colitis occurs when the integrity of the gut lining is compromised.

However, not everyone has the gut microbes essential for converting the polyphenols present in berries and pomegranates into UroA metabolite. Besides isolating the metabolite, a multi-institutional team co-led by Dr. Praveen Kumar Vemula from the Institute for Stem Cell Biology and Regenerative Medicine (inStem), Bengaluru, synthesised an analogue by chemically modifying the naturally occurring metabolite.

The integrity of the gut barrier is maintained by tight junction proteins. Colitis and other inflammatory bowel diseases cause a significant reduction in the levels of the junction proteins, leading to leakage of microbes and toxins from the gut causing acute or chronic inflammation. Restoring the integrity of the gut barrier is therefore essential for treating colitis.

The natural and synthetic metabolites have anti-inflammatory property and also increase the production of tight junction proteins. "But the synthetic metabolite was more stable and more effective in treating and preventing colitis in mice model than the natural metabolite. It was able to prevent and repair the damaged gut barrier and reduce inflammation. Synthetic metabolite even in nanomolar range was sufficient to treat or prevent colitis," says Dr. Sandeep Chandrashekharappa from inStem and a co-author of a paper published in Nature Communications.

The metabolite (both natural and synthetic) repairs the gut barrier by activating a particular pathway (AhR-nrf2) leading to excess production of the tight junction proteins.

In vitro studies

Two different cell lines of the colon and another of immune cells (macrophages)

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were used for the study. A monolayer of colon cells mimicking the gut lining was treated with lipopolysaccharide to induce inflammation and breakage of the monolayer. While lipopolysaccharide destroyed the integrity of the monolayer, there was only minimal inflammation. Both metabolites were able to repair monolayer leakage with the synthetic one being more efficient than the natural metabolite.

In the case of immune cells, lipopolysaccharide treatment caused inflammation and excess production of inflammatory cytokines. Treatment with the metabolites stopped cytokine production and reduced the inflammation. Again, the synthetic metabolite outperformed the natural one.

Animal studies

The researchers induced acute colitis in mice by using a chemical (dextran sodium sulphate). There was increased inflammation and gut barrier leakage. Metabolites given orally led to complete reduction in inflammation and gut leakage repair. To mimic chronic colitis, the chemical was given to the mice for a prolonged period of ten weeks with two weeks of break after each week of chemical exposure. “The animals treated with the metabolites showed no inflammation and gut leakage even during the course of the treatment. We saw the leakage being repaired after two cycles of chemical treatment,” says Dr. Vemula.

A single dose of a different chemical was used to cause acute colitis in mice followed by metabolite treatment. There was much less inflammation and leakage after treatment. “The colon which had shrunk in length due to colitis regained its original length after treatment,” says Dr. Vemula.

Prophylactic property

To test the prophylactic property of the metabolite, mice were given one dose of the metabolite each day for seven days and a chemical was used to cause colitis on the seventh day. The ability of the metabolite to render protection was tested on day 11. “The animals did not develop colitis while the mice

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in the control group showed full-blown colitis," says Anikita A. Hiwale from inStem and one of the authors of the paper.

"We are now making a library of analogues to come up with a synthetic metabolite that is even better than the one currently tested. We are planning for a start-up company for clinical development," says Dr. Vemula.

CCMB uses paper-based device to determine lipid profile

A portable, cheap, point-of-care diagnostics for rapid determination of total cholesterol, HDL, LDL and triglycerides in a single run might become a possible with researchers at Centre for Cellular and Molecular Biology (CSIR-CCMB), Hyderabad successfully fabricating a paper-based microfluidic device. The device has high specificity while the sensitivity is comparable with conventional methods. The device has to be validated with more blood samples.

The flower-shaped device with five arms is printed on a filter paper to simultaneously detect total cholesterol, HDL, LDL and triglycerides; the fifth arm acts as a control. Cholesterol and triglycerides can be detected in less than eight minutes using the microfluidic device. Only 10 microlitre of serum sample is needed to determine the four parameters.

"Sample requirement is less — 10 microlitre of serum. This can be obtained from 25 microlitre of blood," says Dr. ShahilaParween from CCMB and first of a paper published in the journal Sensors and Actuators B: Chemical.

Thefilterpaperisfunctionalisedwithaminosilane(3-aminoproplytriethoxysilane or APTES) and gold nanoparticles. The aminosilane acts as a binder to immobilise both gold nanoparticles and enzymes on the paper surface. While the enzymes react with the serum and help in detecting cholesterol and triglycerides, the gold nanoparticles enhance the intensity of the detection dye to produce a visible change in colour based on the amount of cholesterol and triglycerides present in the sample.

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"For quantifying the amount of total cholesterol, HDL, LDL, and triglycerides we should have a readout device. We are trying to collaborate with researchers from another institute who have already developed a readout device," says Dr. Amit Asthana from CCMB who led the team. Meanwhile, quantification can be done by scanning the paper device and using an image analyser to measure the intensity of colour change in the paper in the reaction zone.

"Till such time we have a readout device, we can use the three colour dots with different intensities present above the reaction zone (where cholesterol and triglycerides are detected) to know if cholesterol and triglycerides levels in the serum are low, medium or high," says Dr. Parween. "Matching the dye intensity with the colour dots by the naked eye can help in semiquanitification."

The serum sample added to the sample zone flows into all the five arms and passes through a narrow channel and a precipitation zone before reaching the reaction zone. The precipitation zone has reagents that are coated on the paper. The reagents react with the sample and allow only HDL or LDL to enter the detection zone in the appropriate arms. The precipitation zone has no reagent in the arms meant for detecting total cholesterol, triglycerides and control.

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Plants might be able to remove lead from soil: study

Researchers from Mahatma Gandhi University, Kerala have identified a native roadside plant that can take up lead from the soil and thus help in removing the metal from the environment. The plant was found to accumulate lead at about 12,000 microgram/g of dry weight in the root and 7,000 microgram/g of dry weight in its shoot.

"These plants grow in soils that are continuously exposed to lead from vehicle exhausts. Though lead additives in petrol and diesel are banned now, some low-quality fuels still have a huge percentage of lead," explains Dr. Joseph George Ray from the School of Biosciences at the University

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and corresponding author of the work published in Ecotoxicology and Environmental Safety.

Highest lead tolerance

Among the hundreds of native plants screened, research done earlier by the group shortlisted three plants. The present study found that Eclipta prostrata had the highest lead tolerance.

E. prostrata or 'False Daisy' is found across the Indian subcontinent. Known 'Bhringraj' (Karisalankanni in Tamil), it is used as a 'hair-growth stimulant' and in many ayurvedic preparations. "The plant may be using the lead to protect itself from the pests, or other predators. Tribal people use it an antidote for snake bites and treatment of scorpion stings," adds Dr. Ray.

Spectrophotometric studies showed increased levels of many enzymes that are known to induce tolerance in plants.

"Hi-tech microscopic analysis showed that the lead travelled to the leaves and was deposited as lead nanoparticles in its cell wall, cytoplasm, and chloroplast. Though we noticed a little distortion in the structure of these organelles no toxicity was seen," explains Chandana Chandrasekhar, the first author of the paper.

Dr. Ray further explains that the plants can be burned up after they have taken up the lead. In this way, the metal can be effectively contained and later disposed off safely.

This study has provided evidence that the plant is a lead hyperaccumulator that has the suitable biochemical machinery. But as the present experiment was carried out using a soluble salt of lead (lead nitrate), more studies are needed in contaminated environments where lead is usually found in insoluble forms.

Bioavailability

To increase the solubility of lead so that it becomes bioavailable to the plant, some solubilising agents (metal chelators) need to be added to the soil;

the plant must be tolerant to such chemicals as well. “Made into a solution, solubilising agents will be added to the contaminated soil. As chelators have long residence time and can percolate well, they will react with the lead in the soil and make it in a form available to the plant,” adds Dr. Ray.

Such experiments using naturally contaminated soils are significant further steps in using the plant for bioremediation of lead-contaminated soil.

A ‘pink revolution’ quietly takes shape in Maharasthra

A ‘pink revolution’ is quietly taking shape in Maharashtra. The objective is to breed imported pigs to address the problem of protein deficiency in a sizeable section of the population that has been deprived of access to affordable meat besides providing livelihood to farmers.

Mumbai-based Gargi Genetics Pvt. Ltd., supported by the Maharashtra government’s policy, is gearing up to create an ecosystem for supply of high quality pork.

The company is planning to partner with farmers by supplying them pigs imported from Canada. They would be bred under hygienic conditions for production of high quality meat.

Many consumers stay away from consuming pork as local pigs are mostly bred under unhygienic conditions.

Gargi Genetics is planning to address this concern through supply of hygienic pork produced from imported breeds in clean environment and is launching an education campaign.

The company plans to build a fully-equipped international-standard piggery that would support animal husbandry, food and medical industry.

While it would create a comprehensive value chain for pork production, it would also supply high quality animals for medical and research industry (organ transplant and insulin), top officials said.

In five years, over 1,000 Maharashtra farmers, in a cooperative format, are

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expected to learn about commercial animal farming with international best practices.

The project has been mooted by finance professional Sandeep Mestry and genetics healthcare exponent Nitin Malekar who have been working on this for years. They had achieved a litter (number of offspring) size of 10 to 14, which is probably the best under Indian conditions.

Profitable idea

"Commercial pig farming in India for meat production is one of the best and profitable business ideas. But the main issue is Indian pig breeds are not suitable for high quality pork production.

"So, we decided to select high quality meat producing pig breeds available around the globe," said Dr. Malekar, director, Gargi Genetics.

"We studied breeds from various countries and zeroed in on three pig breeds from Canada, which are the most suitable for commercial meat production according to the weather and climatic conditions of India," he added.

Indian pork is sold at about Rs. 250 per kg compared with international quality processed pork which is sold at Rs. 1,200- 3,000 per kg.

"The need of the hour is genetically superior quality animals, to enhance the farmer's potential, meet consumers' demand for safe and healthy meat and health industry's requirement for quality animals. It is an industry with huge potential," Dr. Malekar said.

The 'pink revolution' targets to produce five lakh high quality pigs over a period of 5-6 years.

"Pink revolution' plans to offer 'farm to market' solution. We are planning to initiate a franchisee chain of signature shops/eateries to promote healthy pork products," Dr. Malekar said.

The initiative is scheduled to be officially kicked off in the second quarter of 2019 and the company is in process of raising $2 million in equity funding in

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phase I.

The company had already acquired land in Wada in Palghar districtof Maharashtra to start the project.

Microbial fuel cell treats textile wastewater

Microbial fuel cells (MFCs) are fast emerging as an option for several specific requirements. Now, a startup, JSP Enviro, aims to use this technology to process textile wastewater and additionally generate electricity that will render this exercise energy-efficient. Initiated by Suresh Paul Jones, the startup is in the process of joining the bioincubator at IIT Madras, where its other members V.T Fidal Kumar and Priyadharshini Mani will expand the research they have done so far. Now working at the Biotechnology Department of IIT Madras with a prototype of about 200 litre capacity, the team plans to increase it to 1,000 litre capacity by 2020. “Though we have developed the technology for processing wastewater from the textile industry, it can be used with any other industrial wastewater,” says Dr. Mani. The team is also working on the restoration of a lake attached to the Integral Coach factory at Villivakkam in Chennai.

The principle of using the MFC to degrade wastewater is simple. A carefully selected cohort of bacteria is made to act on the textile wastewater placed in the fuel cell. These bacteria are isolated from the very wastewater they are meant to degrade. They feed on the organic material in the water and break it down under anaerobic (without oxygen) conditions, releasing electrons in the process. The electrons are collected at the anode which results in a current in the circuit. Because the bacteria form a biofilm on the anode, the electrons are collected easily by it. “After a period, when the thickness of the biofilm exceeds a limit, it will automatically detach and bring back the thickness to optimal level,” says Dr Kumar. The team is working on a nanotech filter to improve this process. “This is like a ‘trickling filter’ – where after thickness

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exceeds a limit, and it is difficult to sustain that thickness, the excess tears off. When it falls off, it shouldn't get mixed up with the water. That's where the nanotechnology filter will come in, to remove the bacteria and get clean water" he adds.

The bacteria take turns to act on the wastewater and purify it: There are many species of bacteria. If a dye is present in the water, it is broken to a simpler form by one species; this, in turn, is acted on by another species and so on. "It has a cascading effect," says Dr. Kumar.

Using MFC to process wastewater was an idea that the two used in the Carbon zero challenge, a competition hosted by IIT Madras when they were students there. They used the funding obtained through the event to develop the 200 litre prototype within the few months they were given. "We spoke to some people [in the textile industries] at Tiruppur, and they said that if it is cheaper and more energy efficient than current technologies, we will use it," says Dr Mani, describing how they started up.

While now, with the prototype, they can generate power of around 1 watt per square-metre, they aim to get to about 5 watts per square-metre. This power can be used to sustain the process. However, scaling up has challenges. The size of the chamber and its geometry and design remain to be worked out. All the power produced must be captured so that it is not wasted. "For that, we will work with some electrical engineers... ," says Dr. Mani.

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Unique composition of Indian gut microbiome revealed

By studying the faecal samples of over 100 healthy people from Madhya Pradesh and Kerala, researchers from the Indian Institute of Science Education and Research (IISER) Bhopal have decoded the Indian gut microbiome and have created a gene catalogue. Constructed using multiple omics approaches such as genomics and proteomics, the catalogue contains

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details on the different genes coded by the gut bacteria and the functions carried out by the bacteria.

Comparitive analysis

This study also compared the gut microbiome of Indians with people in China, the U.S. and Denmark. The Indian gut microbiome showed higher levels of Prevotella bacteria compared to the other populations. “The presence of these species in high abundance in Indian gut microbiome correlates with the food habits and the diet of the Indian population, which is very different from the other western populations,” says Prof. Vineet K. Sharma from the Department of Biological Sciences at the Institute in an email to The Hindu . He is the corresponding author of a paper recently published in GigaScience .

Faecal samples from 53 people from Madhya Pradesh and 57 from Kerala were used to construct the microbial gene catalogue. The catalogue contains 1,551,581 genes and 943,395 genes out of them were identified as unique to the Indian population. “So about 9% (almost one million) microbial genes were found unique to our population, and were not identified in the integrated microbial gene catalogue constructed from other populations across the globe,” adds Prof. Sharma.

The study also highlighted the differences in microbiome composition between the two states. Samples from Kerala had a higher abundance of short-chain fatty acid producing bacteria such as Faecalibacterium and Roseburia , in addition to Prevotella .

This may be due to the fact that they consumed an omnivorous diet containing rice, fish and meat. Prevotella , the key species in Indian gut was comparatively higher in the Madhya Pradesh population.

This group consists mostly of people eating a plant-based diet and also showed an enrichment of branched-chain amino acid and lipopolysaccharide biosynthesis pathways.

Faecal metabolites

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Using large-scale metabolomics, the study also identified the different faecal metabolites (end products after microbial metabolism) of the Indian samples and mapped their association with the gut microbial species.

"If we have a data of the faecal metabolites, we can compare how it changes during some metabolic disorders and this can serve as simple signatures," says Mr. Darshan Dhakan, PhD scholar at the institute and the first author of the paper. "The results of this study will also help develop pre and probiotics according to our needs."

According to Mr. Dhakan, a drug made and tested in the U.S. may not work for the Indian population. So understanding the gut microbiome will help customise drugs and also develop new strategies for tackling the metabolic diseases by correcting the imbalance in the gut microbiome.

IGIB: TB bacteria use a new way to subvert host defence

It is well known that TB bacteria can actively manipulate the degradative pathway of macrophages (cells responsible for detecting, engulfing and destroying pathogens) such that instead of getting destroyed, the TB bacteria can actually multiply inside the macrophages. Now, researches at the Institute of Genomics and Integrative Biology (CSIR-IGIB), Delhi have for the first time found that TB bacteria actively manipulate an organelle other than those involved in the degradative pathways. They found that protein composition of lipid droplets is actively manipulated by TB bacteria.

New mechanism

Lipid droplets are storehouses of lipids inside the host cells but can be decorated with specific proteins. Previous studies have shown how the composition of proteins in lipid droplets gets altered during different physiological conditions. So understanding how the protein composition of macrophage lipid droplets changes in response to TB infection may help

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in shedding light about a new mechanism through which the TB bacteria subvert the host defences.

It is already known that TB bacteria utilise lipids from the host cells and compete with the host cell for nutrients stored inside the cells. So the team led Dr. Sheetal Gandotra from IGIB set to study how the lipid droplet organelle gets actively modified by live TB bacteria leading to changes in the protein composition.

Theresults were publishedin the journal ACS Infectious Diseases .

The lipid droplets in macrophages infected with live TB bacteria altered the composition of 86 proteins. While there was increased abundance of 57 proteins, the abundance reduced in the case of 29 other proteins.

Predict pathways

“All that we know now is that there is a change in the abundance of certain proteins. But at this point we don’t know the causal relationship between the changes in abundance and lipid metabolism,” says Dr. Gandotra.

By knowing which proteins’ abundance are altered, it is possible to predict which pathways are being affected. “The lipid metabolism can impact different pathways through changes in the recruitment of proteins that are involved in these pathways or these proteins can have an impact on lipid metabolism directly,” says Dilip Menon from IGIB and first author of the paper.

Based on the increased abundance of certain proteins, the team has found that protein synthesis pathway and vesicular trafficking pathway have an unprecedented link with lipid metabolism in the context of infection.

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Deep sea treasures

Hydrothermarchaeota, or microbes living in extreme environments may hold clues to the evolution of early life. These microbes use carbon monoxide and sulfate as sources of energy - chemosynthesis. Published in The ISME Journal, the study used genomic approaches to unravel the secrets of its

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survival. It may help predict about extraterrestrial life.

Decoding how leptospirosis bacteria interact with human proteins

By studying proteins from leptospirosis-causing bacteria and the human body, researchers have identified the key pathogen-host protein interactions that are responsible for the development of the disease.

By using a wide range of advanced bioinformatics and mathematical models, the team was able to narrow down to 35 interactions between 13 bacterial and 35 human proteins that may hold potential for vaccine development. A total of 145 well-characterized proteins from the bacteria and 493 proteins from the human body were analysed to draw the conclusion.

Leptospirosis is one of the emerging zoonotic diseases and causes almost 60,000 deaths every year as there is currently no preventive vaccine for humans. The researchers studied the proteome (entire protein set) of Leptospira interrogans — the most vulnerable species — and the proteome of human beings.

Interaction network

They analysed the inter-species and intra-species protein interactions and constructed a pathogen-host interaction network which was further studied using mathematical models to identify the key interactions.

Out of the 586 pathogen-host protein interactions, 35 were identified as key interactions. “When we get an infection, the whole protein network system in our body is disturbed. We tracked the bacterial proteins and found that they are directly attacking the proteins associated with the immune system in our body,” says Swapnil Kumar’ who is first author of the paper published in Scientific Reports.

Also, two outer membrane proteins and two periplasmic proteins of the bacteria which take part in the interactions were found conserved. These proteins target human proteins involved in functions such as signal transduction,

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antibacterial humoral response, cell cycle and cell division. This signifies that these proteins can be explored further for effective and novel therapeutics and vaccine development.

"Validations of the findings are under way in mice model," says Dr. Jayashankar Das, the corresponding author of the paper from the Gujarat Biotechnology Research Centre, Gandhinagar.

Artificial leaf

Researchers from The University of Illinois at Chicago have developed a new leaf, which can take up carbon dioxide from the air, almost 10 times more than natural leaves and convert them to carbohydrates.

Tool tactics

A new study published in PLOS ONE has shown that orangutans are capable of flexible tool use. They can make complex decisions about out-of-reach food and decide if the available tool would help do the task.

IIT-H's device detects heart attack early

A low-cost, ultra-sensitive device that is capable of detecting the cardiac biomarker troponin T protein has been fabricated by a research team from the Indian Institute of Technology (IIT) Hyderabad. Troponin T is a cardiac protein that is released into the bloodstream after a heart attack.

Unlike the commercially available test that can detect the protein at nanogram per ml concentration, this device can detect the protein at an extremely low concentration of femto gram per ml. This could help pave the way for early diagnosis of a heart attack, increasing a patient's survival rate. It even has the potential to be able to predict the onset of a heart attack.

Cost-effective fabrication

Unlike electrodes that are available, it costs very little to fabricate this

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bioelectrode. This is because a commercially available substrate was used. Further, very little antibody was needed to coat the electrode.

The electrode was fabricated by depositing perovskite (zinc tin oxide) material electrochemically onto the substrate (indium tin oxide coated polyethylene terephthalate). Glassy carbon electrode coated with the same perovskite material was then used as a control. Perovskite increases the volume-to-surface area of the electrode, thereby increasing its sensitivity.

The electrodes coated with perovskite were then functionalised to attract proteins. To increase the specificity of the electrode to bind only to the troponin T protein, the electrodes were decorated or coated with the troponin T antibody.

Test findings

The researchers added various concentrations of the biomarker (ranging from 1 femtogram per ml to 1 microgram per ml) to a buffer solution and measured the impedance (effective resistance in alternating current). Says Prof. Shiv Govind Singh from the Department of Electrical Engineering and corresponding author of a paper published in the journal Analytical Methods , "Compared with the current limit of detection, the bioelectrode was able to detect troponin T even when it is 10,000 times less in concentration."

When the troponin antigen binds to the antibody present on the electrode, the impedance increases. Adds Prof. Singh, "As more and more biomarker binds to the antibody, there is increased impedance, which is what we measure." After some time, the electrode is saturated with the troponin protein, so no change in impedance is seen.

The researchers measured impedance using different concentrations of the protein. They plan to use these impedance values to know the concentration of the protein when testing actual blood samples. Says Prof. Singh, "We can measure the impedance in real time. And by using a machine

learning algorithm, we can measure the concentration of the biomarker in the sample."

To test the selectivity of the bioelectrode to bind to the biomarker, the researchers tested it on bovine serum albumin (BSA) and human serum albumin (HSA).

Says PattaSupraja from the Department of Electrical Engineering at IIT Hyderabad and first author of the paper, "Only a slight change in relative resistance was observed in the case of HSA and BSA as only a small amount of proteins [from HSA and BSA] bind to the bioelectrode. This is unlike troponin where more protein gets bound to the bioelectrode, leading to more impedance."

She adds, "We then tested for interference by mixing the same amount of biomarker with either BSA or HSA. The sensor's response was not adversely affected by either BSA or HSA." The bioelectrode also showed consistent values when measurements were taken repeatedly using the same concentration of the biomarker.

Focus on miniaturisation

The team is now working on how to miniaturise the readout instrument. Says Prof. Singh, "We will soon be able to capture the signal using a circuit the size of a chip. This will be connected to [a] mobile phone with an app that has a machine learning algorithm for quantification of the troponin biomarker." He adds, "We will have the prototype ready in six months to one year."

A smart indicator to boost frozen food safety

The temperature at which food products are stored is vital in ensuring their quality. For example, in retail outlets across India, power failure and repeated opening and closing of freezer storage units in which food products are stored can lead to temperature fluctuations. These in turn can affect the quality of

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food, especially perishable food, leading to microbial growth. Temperature fluctuations can also affect vaccines and drugs that are stored in cold storage or at below room temperature.

Researchers from the Indian Council of Agricultural Research-Central Institute of Fisheries Technology (ICAR-CIFT), Kochi, Kerala, in collaboration with the University of Wisconsin, Madison, U.S., have now found a way using gold nanoparticles that they synthesised to help tell if frozen food is still edible.

How it works

The nanoparticles change colour in response to changes in temperature. They become ruby red (similar to the colour of red wine) at -18° C and turn purple when the temperature rises. At room temperature, their colour is dark grey.

To synthesise the nanoparticles, the researchers used chitosan, a natural biodegradable polysaccharide that was extracted from marine waste such as shrimp and crab shell. A solution of chitosan and gold chloride solution was heated for about 30 minutes at 90° C. Though the sample preparation process was simple, care was taken to maintain proper conditions such as temperature, stirring and base concentration of the gold solution.

The nanoparticles remained stable when tested at -18° C. Their colour and other physical properties remained intact even at the end of 30 days of testing at -18° C.

Explains Dr. C.O. Mohan, Senior Scientist, ICAR-CIFT, Kochi and corresponding author of the work that has been published in npj Science of Food , “The colour change of the nanoparticles is irreversible. So once they change from red to purple or grey when the temperature increases, the original colour cannot be regained even if the temperature is brought back to -18° C.” He adds, “They can be attached to the outer surface of the food or pharmaceutical packs as a visible indicator without coming in contact with

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the product."

Looking ahead

According to him, such smart indicators can be made using a very small quantity of chitosan-gold nanoparticle solution to identify frozen temperature abuse. It would cost less than Rs. 2 a pack. The team is also working to develop smart indicators from nanoparticles of other metals to further reduce the cost.

Wind loses energy as policy paralysis blows through this renewable sector

From a euphoric 5,500 MW in 2016-17 — when wind energy companies rushed to commission their projects so as to get their foot in before certain incentives expired — capacity additions have plummeted, to 1,762 MW in 2017-18 and an estimated 1,600 MW in 2018-19.

Notably, at the beginning of both the years, expectations were high. After 2016-17 ended with 5,500 MW, an ecstatic industry predicted 6,000 MW for 2017-18. That didn't happen, but still, many projected a boom for 2018-19. Now, when the record is dismal again, there are some (like Tulsi Tanti, CMD of Suzlon Energy) predicting record high installations in 2019-20, while others (such as market research company Crisil) are not so optimistic. So, each year begins with high expectations and ends in dismal performance. What is happening?

The situation would have been very different if only policymakers had thought things through and the government had been more helpful. But first, some background.

Unlike solar, wind power plants cannot be put up anywhere but only in locations where winds blow strong. In India, there are eight States where it is economically viable to put up wind turbines —Tamil Nadu, Gujarat, Karnataka, Maharashtra, Madhya Pradesh, Rajasthan, Telangana and

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Andhra Pradesh.

For about two decades, wind energy firms (called 'developers') would erect the turbines at chosen sites and sell power to the electricity supply companies at prices fixed (called 'feed-in tariffs, or FiT) by the respective State electricity regulators. The developer would get the FiT for the entire power purchase agreement period, typically 25 years.

Because only eight States constituted the 'market', annual fresh capacity installations used to be in the 1,500 MW — 3,000 MW corridor. Expanding the market meant that the other States also should buy wind power. This could not happen because of difficulties in putting up projects in one State and selling the electricity to another.

Centre steps in

That was when the Centre stepped in. As soon as the BJP came to power in 2014, it fixed a target of 1,75,000 MW of capacity for renewable energy of which 1,00,000 MW would be solar, 60,000 MW wind and the rest biomass and small hydro.

To make the 60,000 MW happen, the Government of India (through its new company, SECI), became a trader — it would buy power from the developers and sell it to the non-windy States, thus expanding the market. Developers who offered to sell at the least prices would get to sign long-term power purchase agreements; they could put up their projects anywhere, but should deliver the power at a substation. Thus began the epochal shift from fixed FiTs to market-determined tariffs.

What also began was — trouble. The first round of auctions closed in February 2017. Due to competition, developers offered to sell electricity at prices as low as Rs. 3.46 a kWhr; in contrast, the least FiT was Rs. 4.16 in Tamil Nadu. Now, upon seeing prices fall so low, the windy States began to ask themselves, 'why should we buy power at the costly FiT prices; why not

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we also conduct our own auctions to buy cheaper power?' But they didn't know the mechanics of the auctions and had to wait for some guidelines from the central electricity regulator. As they dithered, the 'windy State market' vanished. But the Centre too dragged its feet on further rounds of auctions. In 2017-18, just two auctions, for 2,000 MW, happened. The year ended on a dismal note.

In due course, activity picked up and till now, six rounds of SECI's, and several more of different States have happened and about 13,000 MW of capacity have been awarded. Prices dropped consistently, and fell to a low of Rs. 2.44 in the third round.

At this stage, two other problems arose. First, to be viable at such low prices, developers flocked to the two windiest States — Gujarat and Tamil Nadu.

All of the SECI-awarded projects (70% of all auctioned capacities) went to them, which was more than the ability of the substations to take the power.

Second, Gujarat frowned at 5,400 MW worth of projects coming up on its soil but all the power going to the non-windy States. Would there be any lands left for its own auctions? So, it refused to give land and came out with a policy that forced developers to put up their projects in specified 'wind parks.' Since the parks are not necessarily the best sites for wind projects, the developers didn't like the policy. Negotiations began, project work got delayed.

More problems

The problems didn't end there. As the best sites got taken, prices began to rise after from the fourth SECI round. Governments, suspecting a developers' cartel, began imposing tariff caps — or the highest price they would accept. And they began cancelling auctions at ripe stages. Notably, the benefits of the low tariffs have never been passed on to the consumer — the electricity supply companies have pocketed the benefits.

The industry has been asking the government to do 'substation-wise auctions',

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('what is the cheapest best price you can offer if your wind turbines would be connected to this particular substation?') The government is hesitating, apparently because substation-wise auctions will result in higher price quotes.

Of the 13,000-odd MW tendered, the deadline for completion has expired for 2,000 MW; but so far only 823 MW has come up. More auctions are set to happen. So, the question is, while there is a fat backlog and a healthy 'order pipeline,' will the projects come up? Mr. Tanti believes they will and says 2019-20 will see a record of 8 GW; Crisil disagrees — it projects 3,800 MW for the year. The worst sufferers in the mess are the 4,000 SMEs who supply components to turbine manufacturers and their two million employees.

A gel to selectively remove oil or water

A natural biopolymer, chitosan (a kind of polysaccharide obtained from a chitin shell such as the shrimp's), which is water-soluble, has been chemically modified by researchers at the Indian Institute of Technology (IIT) Guwahati to selectively remove either an oil or water phase from an oil-water mixture. This becomes possible by making the chitosan-based material, also biodegradeable, to exhibit either an extremely water-repelling property in air (like the lotus leaf) or an extremely oil-repelling property under water (like a fish scale).

In a breakthrough, the researchers have also made it possible to switch the chitosan-based material's property — from being extremely water-repelling to extremely oil-repelling and vice-versa — by treating it with certain chemicals. It is also possible to repeatedly switch from one property to another.

Fabrication

To prepare the water or oil repelling chitosan, a team led by Dr. Uttam Manna from the institute's Department of Chemistry and Centre for Nanotechnology

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first converted the material into nanoparticles and then to a stable gel material by treating it with a chemical (5Acl). This gel was found to have chemically active residues (amines and acrylate), which when treated with a small amine resulted in optimisation of the two very different properties in the same material.

Says Nirban Jana from the institute's Department of Chemistry and first author of a paper published in the journal Chemistry of Materials , "This is the first time that the liquid repellency property of the material is made switchable, from superhydrophobic to superoleophobic under water and back to superhydrophobic by treating the material at low pH and ethanol, respectively."

The chitosan — which is converted into a stable gel — allows the researchers to selectively remove the oil or water phase from an oil-water mixture by making the material either superhydrophobic or superoleophobic, respectively. For example, if the oil spill (in water) is less, the material can be made water-repelling to remove or collect the oil. In case the spill is huge and the water phase relatively less, the material can be made extremely oil-repelling to collect or remove water.

Property switch

By treating the material with acid (pH 1) for about 15 minutes, the team (led by Dr. Uttam Manna from the institute's Department of Chemistry) was able to completely switch the property of the material — from being extremely water-repelling to becoming extremely oil-repelling under water.

Similarly, by treating the biopolymer with ethanol for 10 minutes followed by air drying, the team was able to switch the property from being oil-repelling to becoming water-repelling.

Says Dr. Manna, "The water contact angle of the superhydrophobic biopolymer is over 152º and the oil contact angle under water is nearly 159º." The higher the contact angle the greater is the liquid repellency of the material.

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Superior performance

The researchers tested the ability of the biopolymer to separate oils — kerosene, motor oil, olive oil and even crude oil — of different densities from water. Says Dr. Manna, “Under water, we were able to completely remove even crude oil from the water phase. The selective separation efficiency for both oil and water phases was above 95% immaterial of the viscosity of the oil.”

The biopolymer’s superhydrophobic property remained intact under diverse chemical conditions such as extreme pH (pH 1 and pH 13), sea and river water for seven days, and high (100º C) and low (10º C) temperatures.

The material was found to retain both hydrophobicity and oleophobicity even when the top surface of the biopolymeric material was physically abraded using sand paper. Despite the abraded surface being cleaved through manual peeling using an adhesive, the liquid repellence property remained intact. No change in this was seen after the mechanically damaged material was subjected to even a continuous stream of sand grains. Exposure to UV light for a month too did not destroy this repellence property.

The lost tail that wags research tales

A lizard, when attacked, loses its tail and runs for safety. Within 60 days, the tail is regrown. What is the biology behind this? This question was recently addressed by Dr. KenroKusumi and colleagues at Arizona State University in the U.S. (PLOS ONE , August 20, 2014). They found that a lizard turns on as many as 326 genes of its genome in specific regions of the regrowing tail to do so. It also turns on what are called “satellite cells” which can grow and develop into skeletal muscle and other tissues. One of the authors has suggested that since humans too have such satellite cells, maybe we too can regrow muscles and cartilage if we can harness them in us.

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Lizards are a late entry into the world, having first arrived on earth around 310-320 million years (Myrs) ago. Preceding them are earthworms (518 Myrs) and flatworms (840 Myrs), which were called 'the intestines of the earth' by Aristotle and 'the earliest ploughers' by Darwin. In a recent paper (Zattara et al. Proc. Royal Soc. B 286:20182524), scientists studied the way how 35 different species of worms regenerate their body, after parts of their bodies were chopped off. At least four separate types of worms could regenerate their heads. Studying the biology of these organisms would be remarkably insightful, as has been attempted with lizards.

Up the evolutionary ladder

Why can worms even regenerate their heads, but the later-day arrivals, lizards, can only rebuild their tails, and 'higher animals' cannot even do that? There are two kinds of analytical arguments towards this. Professor Alexandra Bely, an expert in the area from the University of Maryland, U.S. has a review titled 'Evolutionary loss of animal regeneration: pattern and process' (doi:10.1093/icb/icq118), where she argues that while regeneration can produce cells, tissues and internal organs, the regeneration of structures such as limbs may be governed by age, sex, nutrition and other factors. Plus, is regeneration given up, or is selected against -- based on the energy and metabolism being invested more for growth rather than repair? We need to research into the energy cost-benefit analysis in order to understand the matter further.

A more recent analysis is by Dr. Jonathan Slack of the University of Bath, U.K. titled 'Animal regeneration: Ancestral character or evolutionary novelty?' which appears in EMBO Reports 2017 . He points out using genetic analysis, that the ancestral character in all organisms is reflected by the expression of two major genes, conserved across all animals — lizard to human — namely Wnt and BMP. Wnt mediates the developmental pathway implicated in proliferation of cells and in self-renewal signals. BMP is another gene, seen

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again from fruit flies all the way up to us, and the BMP-mediated pathway too plays a key role in organ and body development. The fact that these genes are present in all cells of all animals would seem to make organ regeneration possible in principle.

But then, once the tail is lost, in say a rat or a cat, it does not regenerate. They just make do without the lost tail. Dr. Bely points out that the bio-energetic cost of regenerating the tail here does not appear worthwhile when the animal can make do without it. (Indeed, the lizard seems to need the tail as an important organ, in order to survive and flourish — it is what Slack might call as an evolutionary novelty; its predecessors did not 'invent' this important appendage.)

Come back to the lizard again. Actually the regenerated tail is not identical to the lost one, but an "imperfect replicate" as was shown by Lozito and Tuan (Dev. Biol.2015,399, 249). Instead of the original vertebral tail, the regrown one had no bones but a softer, more flexible cartilage. In other words it is what Dr. Sukla Ghosh of Kolkata had described as a 'compensatory growth' rather than true regeneration.

The promise of stem cells

While the Arizona group, working on the cell biology of the regenerated lizard tail, did not find any specific progenitor cells or stem cells of the tail tissues, the newly emerged stem cell technology is generating a lot of excitement in the field. Stem cells found, for example in the bone marrow, can be cultured in a laboratory to produce cells and tissues of a few other parts of the body. This has been done in generating a bladder and stitching it on to a youth who had a bladder injury. In recent times, any cell in the body can be "induced" to become a stem cell upon the introduction of four chosen genes. The so produced induced pluripotent stem cells (iPSCs) have been used in the laboratory to generate chosen tissues and even mini-organs called

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"organoids". While this field is still in its infancy, it promises to produce organs which, when needed, can be used for regeneration.

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IIT Madras converts petroleum waste toluene into useful product

Using platinum nanocatalyst, a two-member team at the Indian Institute of Technology (IIT) Madras has successfully converted petroleum waste-product toluene into benzoic acid. Benzoic acid is used as a food preservative (E210) and medicine for fungal/bacterial infection. Toluene is converted into benzoic acid through selective and controlled oxidation in the presence of a catalyst — binaphthyl-stabilised platinum nanoparticles (Pt-BNP).

Green oxidant

Generally, organic reactions are carried out using organic solvents, which makes it expensive and also generates toxic waste. So in a departure from current practice, the team led by G. Sekar from the institute's Department of Chemistry has used water as solvent to make it environment-friendly. Also, a green oxidant (70% aqueous tert-butyl hydroperoxide or TBHP) is used for converting toluene into benzoic acid.

"When toluene is oxidised, it gives four products. But when we use the catalyst that we developed, only benzoic acid is produced. No alcohol, aldehyde or ester is produced," says Prof. Sekar. The yield of benzoic acid varied from 68-96% depending on whether the toluene used is electron-deficient or electron-rich. The results of the study were published in the journal Applied Catalysis B: Environmental.

Central to the work is the novel catalysts that the team developed. Generally, platinum nanoparticles are not stable in nature as they tend to agglomerate and become macroparticles. The catalytic activity is reduced once it becomes macroparticles. The binaphthyl that is bound to platinum nanoparticles acts as a stabiliser and prevents nanoparticle agglomeration.

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"Binaphthyl bound to platinum nanoparticles makes the catalyst easy to handle and stable. It is the stability of the catalyst to remain as nanoparticles that allows us to recover it and reuse the catalyst up to five times," says Prof. Sekar. There was no change in the size of the catalyst even after being reused five times.

Toluene when oxidised gets converted into benzoic acid. Molecular oxygen when used alone does not oxidise toluene and so no benzoic acid is generated. So the researchers used TBHP as an oxidiser. "The catalyst reacts with TBHP to initiate the oxidisation reaction where toluene gets converted into benzoic acid through a series of reaction steps," says RajibSaha, a PhD student at IIT Madras and co-author of the paper.

Economical combination

When used alone, a large quantity (four parts of TBHP to 1 part of toluene) of TBHP would be required for the conversion, which will not be economically favourable. In order to reduce the amount of TBHP used, the researchers also used molecular oxygen.

"In the presence of molecular oxygen, only two parts of TBHP are needed for the conversion. So molecular oxygen behaves as a co-oxidiser," says Prof. Sekar. "Molecular oxygen is cheap, so using it along with TBHP helps in reducing the cost." The use of TBHP along with molecular oxygen also increased the yield of benzoic acid.

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Order on surveillance meant to protect privacy, govt. tells SC

The Centre told the Supreme Court that its December 20, 2018 notification allowing 10 central agencies to snoop on people is in fact a measure to protect citizens' privacy.

The government was responding to a PIL filed by advocate M.L. Sharma, challenging the December 20 notification as a violation of the fundamental right to privacy.

The order allows central agencies, from the Intelligence Bureau to the Central Board of Direct Taxes to the Cabinet Secretariat (RAW) to the Commissioner of Delhi Police, to intercept, monitor and de-crypt "any information" generated, transmitted, received or stored in "any computer resource".

The order is based on Section 69 (1) of the Information Technology Act of 2000 and Rule 4 of the Information Technology 2009 Rules (Procedure and Safeguards for Interception, Monitoring and Decryption of Information) Rules, 2009.

Turning the argument on its head, the Centre said the order, in fact, limits the power of surveillance to these 10 central agencies and none other.

"What has been done under the December 20 order is in fact restricting the exercise of powers, removing a possible vagueness and specifying the agencies/organisations who only would have the powers to utilise the powers of section 69 of the Act," the Centre said.

'Restricted powers'

It said the very purpose of the December 20 order is to ensure that surveillance is done as per due process of law; that any interception, monitoring, decryption of computer resource is done only by authorised agencies and with approval of competent authority; to prevent unauthorised use of these powers by any agency, individual or intermediary so that the right to privacy of citizen is not violated.

The government said surveillance is necessary "in the modern world where

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modern tools of information communication, including encryption, is used". Surveillance is done only in the defence of India, to maintain public order, etc.

"There is no blanket permission to any agency," the government explained. Permission for surveillance needs to be got from the Union Home Secretary. Besides, the law mandates the Centre and States to constitute a review committee with the Cabinet Secretary.

The affidavit explained how there are "grave threats to the country from terrorism, radicalisation, cross border terrorism, cyber-crime, drug cartels", and these cannot be ignored or under-stated. There is a need for "speedy collection of actionable intelligence" to counter threat to national interests.

"It is therefore imperative that requests for lawful interception or monitoring must be dealt with by the executive authority to maintain speed in taking decisions. A well laid down procedure for oversight by a panel headed by the Cabinet secretary doubtlessly ensures that provisions of law, rules and SOP are adhered to," the Centre said in its counter-affidavit.

RailTel is turning railway stations into digital hubs

The Indian Railways has one of the world's largest public WiFi networks in RailWireWiFi.

With around 2.6 crore users logins in a month, and over 9,491 Tetra Byte (TB) of aggregated data consumption, RailWireWiFi at 746 railway stations across the country is only getting stronger.

The network, provided by RailTel, a 'Mini Ratna' central PSU (Public Sector Undertaking) under the Ministry of Railways, is not only one of the largest but also one of the fastest public WiFi networks.

"The response to the high speed service provided as part of turning railway stations into a platform for digital inclusion has been phenomenal," sources

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in RailTel told The Hindu . Bona fide passengers are using this WiFi facility for streaming high definition (HD) videos, and downloading movies, songs and games, and engaging with their office work online, says RailTel.

For a modern handset, the speed can go as high as 40 Mbps for the initial 30 minutes of unhindered open access, which is unmatched on any other network.

The backbone capacity of each of these railway stations is 1 GBPS.

Free WiFi services to commuters are being provided under 'RailWire', RailTel's retail Broadband initiative. Of the 746 railway stations, RailTel has provided high speed WiFi at 414 A, A1 and C category railway stations across the country, in association with Google as the technology partner.

Currently, 21 railway stations in Kerala have free WiFi, and a project to provide free WiFi to 100 more stations this fiscal as part of the Corporate Social Responsibility initiative of a Mumbai-based trust through RailTel is on the anvil, officials said.

App launched with R-Day highlights

People can watch the highlights of this year's Republic Day parade at the Rajpath on a mobile application launched by the Defence Ministry.

The 'RDP INDIA 2019' app was launched on the 70th Republic Day.

"It was extremely informative to the spectators witnessing the parade and was widely appreciated," the Ministry said in a statement.

The app also had the provision for live streaming of the parade and contains information about it, including the order of the march, details of the tableaux presented by different States and Ministries, cultural performances by children, fly past and names of recipients of Pradhan Mantri Rashtriya Bal Puraskar, 2019, the statement said.

According to the statement, this new initiative is in sync with the Digital India

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campaign of the government.

The Ministry said the app would help people who desire to know the theme and ideas depicted in the tableaux.

India to have own DNS for safe browsing

The government will soon roll out a public Domain Name Server, or DNS, for India aimed at providing a faster and more secure browsing experience for Internet users in the country, while ensuring that citizens' data is stored locally.

A DNS is a like a directory for the Internet. It helps to convert domain names that are easy for people to remember into IP addresses, which are used by computers/machines to communicate. If the DNS is either slow or fails to work, users will not be able to locate web addresses.

"The main aim of bringing our own public DNS is to ensure availability, particularly for smaller Interest Service Providers (ISPs) who don't have credible DNS. Bigger ones usually have their own DNS," an IT Ministry official said.

Pointing out that there were other open DNS servers, including Google Public DNS, the official said the government's system would prevent users from visiting malicious websites.

The roll-out, which will be executed by the National Informatics Centre – the technology arm of the government – will be completed in the next four to six months, the official said. NIC is already using the public DNS within the government network.

'Mechanism in place'

Asked if the move would enable the government to block content or help in surveillance, the official said, "If the government wants to block a website, we have a mechanism in place. We can send a list to the ISPs for reasons

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such as child porn or fake news, and they have to comply with the order."

"If you use any public DNS, they access and use all your data. It is not that users will compulsorily need to shift to India public DNS. A user is free to choose any DNS," the official said, adding that with the government's public DNS, Indian users' data would be stored within the country.

The ministry, as part of its ongoing awareness campaign for safer Internet, also plans to reach out to end-users to educate them on DNS and how they could shift to an Indian public DNS if they desired.

Signs point to a gunman steeped in far-right Internet culture

A camera mounted to his head, the gunman who livestreamed part of his savage attack on two mosques in Christchurch, New Zealand, began his video by casually making reference to a current Internet meme.

He appeared to be steeped in the culture of the extreme-right Internet. And in the terrible minutes of video that followed, he proved to be a nonchalant, unrepentant killer.

As of Friday night, the gunman had not been identified by the authorities. But just before the attack began, a man who said he was a 28-year-old from Australia published a link on a right-wing forum to an 87-page manifesto, and another link on the same forum to a personal Facebook page with the video that would soon document the slaughter.

Based on the video, the manifesto and social media posts, a picture has begun to emerge of a man primarily driven by white nationalism and a desire to drive cultural, political and racial wedges between people across the globe. That, he hoped, would stoke discord and, eventually, more violence between races.

Australia's main public broadcaster reported that the Facebook user worked as a personal trainer at a gym in the city of Grafton after finishing school in 2009 until 2011, when he left to travel overseas. Where exactly his travels

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took him was not immediately known, but the manifesto's author wrote that he explored much of Europe in the spring of 2017.

And a man using the same name visited Gilgit-Baltistan in October, people at two hotels there confirmed.

Asghar Khan, the manager of operations at the Serena Hotel there, said the man seemed like a "nature-loving" traveler.

Trolling tactics

The gunman appeared to pair the shooting with the typical trolling tactics of the Internet's most far-right instigators, playing to a community of like-minded supporters online who cheered him on in real time as they watched bodies pile up.

And the manifesto states plainly what usually goes unstated by Internet trolls: by design, its author wanted to get everyone upset and arguing with each other.

One of the goals of his bloodshed, he wrote, was to "agitate the political enemies of my people into action, to cause them to overextend their own hand and experience the eventual and inevitable backlash as a result." He said he wanted to "incite violence, retaliation and further divide".

The manifesto, the video and what appear to be the gunman's social media posts feature typical white nationalist rhetoric. The gunman seems to have a significant interest in history — at least, the parts that fit into a white nationalist narrative. On his weapons, he wrote the names of centuries-old military leaders who led battles against largely non-white forces, along with the names of men who recently carried out mass shootings of Jews and Muslims.

The manifesto refers to non-whites as "invaders" who threaten to "replace" white people.

The author says he used guns instead of other weapons because he wanted

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the U.S. to tear itself apart arguing over gun laws.

His choice of language, and the specific memes he referred to, suggest a deep connection to the far-right online community. The link to the livestreamed video was first posted to a forum of 8chan, a notorious far-right space, where the gunman was hailed as a hero after the shooting. Some of his references were subtle. As he drove to the mosque, he listened to a song associated with a 1995 Serbian nationalist video, which has recently been co-opted as a racist meme.

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Agri-tech firms hail order

An alliance of seed and agriculture technology companies, including major global players, has welcomed Tuesday's Supreme Court verdict regarding Monsanto's patent claim as a victory for research and innovation in agriculture.

However, the company which had challenged the claim, Hyderabad-based Nuziveedu Seeds, insists that the Supreme Court has not actually adjudicated on the validity of the patent.

"The Supreme Court has restored the order of the Single Judge Bench of the Delhi High Court which prima facie validates our patent and has sent it back for a full trial by evidence considering the complexities involved," said a spokesperson of Bayer, the global giant whose crop science division acquired Monsanto last year.

Bayer and Monsanto are founding members of the Federation of Seed Industry of India (FSII), an association "driven by the fundamental value of respecting research and intellectual property of each other."

Paddy farmer 'seeds' a success story

At a time when many a farmer in Wayanad district is keeping his paddy field fallow owing to huge losses, T. Praseed Kumar from SulthanBathery is scripting a different story — one of hard work, perseverance and fine imagination.

The 45-year-old farmer's journey to success began after he got a handful of paddy seeds from a friend in Gujarat.

'Krishna Kamod', the Basmati rice variety for which he got the seeds, is known for its taste, colour and aroma. Enticed by its violet chaff, he first cultivated it on just a cent of land.

Gradually, in a period of seven years, he expanded the cultivation to one hectare and last year, Mr. Kumar harvested about 2,500 kg of the rice.

And instead of selling the rice in the open market, he sold the seeds to farmers

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at Rs. 200 a kg.

He had spent Rs. 85,000 for the cultivation last year and got returns to the tune of Rs. 5 lakh.

Buoyed by the success, Mr. Kumar tried his luck this season with Black Jasmine rice, a medicinal rice variety from Assam that is violet in colour.

100 kg of seeds

He spent Rs. 25,000 on cultivating it on 50 cents of land and harvested 400 kg of the rice. “I have sold 100 kg of the rice seeds to farmers at Rs. 400 a kg and some traders, who have been selling premium varieties of rice online, have offered to procure the remaining quantity of rice at Rs. 500 a kg,” Mr. Kumar added.

Mr. Kumar acknowledged the timely assistance provided by T. Girija, project director, Agricultural Technology Management Agency, Wayanad, for the cultivation.

He had also received an incentive of Rs. 20,000 from the Agriculture Department.

‘“As there is a huge demand for the seeds of rare rice varieties among the farming community in the country and pesticide-free rice from the elite class of society, I am trying to tap the huge potential,” Mr. Kumar said. The Black Jasmine variety has huge demand from supermarkets in the country as well as abroad, he said.

Mr. Kumar has also launched a website to market the seeds.

“This rice variety [Black Jasmine] seems quite suitable for the district, though its market is yet to be tapped properly in the State,” Sebastian Joseph, Assistant Director, Agriculture Department, Wayanad, said.

However, many farmers had come forward to cultivate the crop as it fetched a better price in the market, he added.

Mr. Kumar’s farm had been selected as a ‘demonstration plot’ last season to promote the rice variety.

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The farmer has also dabbled in the cultivation of spectra of rice varieties.

As you reap, so shall you add value to farm produce

A fusion of traditional practices, management expertise and technology has taken agriculture to a higher level at a farm located in Udayampuli Village of Tirunelveli district. Jaycee Agro Farms has emerged as a model in which the farmer is in control of the food chain — from production to marketing.

The farm, spread over 200 acres (and an additional 250 acre of leased land), adopts a biodiversified cropping pattern (paddy, fruits and vegetables) and is home to about 51,000 trees, all belonging to native species. It has an interconnected drip irrigation network with six percolation ponds, six open wells and 28 borewells, in addition to rainwater harvesting infrastructure.

The water grid, which can be operated with an Android phone, ensures uninterrupted supply. The organic, bio and biodynamic manure and pesticides produced at the farm are tested in an in-house laboratory. The dairy unit provides the ingredients for manure production. Units are being set up to process fruits, vegetables; produce herbal powders and cold-pressed oils.

Lack of value addition

“Our objective is to prove that farming can be very profitable. Farmers suffer due to absence of processing and value addition facilities. They can give us their produce raised as per our specifications for value addition and we assure them a price much higher than the market price,” said K. Jayachandran, one of the two promoters. He picks out moringa, basil, lemon and amla as crops that fetch good prices in the export market with value addition in the form of amla juice, moringa powder, curry leaves powder and the like. The farm has achieved breakeven within a few years of operation.

It is networking with nearby villages to improve productivity and income of small and marginal farmers. The farm is also used to provide training in

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organic and biodynamic farming in association with government agencies and promote agro-tourism. Work has begun to make it a biodynamic farming education centre of the Biodynamic Association of India. “We want to make farming a cooperative movement that functions on good corporate principles,” said Mr. Jayachandran.

Biodynamic agriculture, a new method of farming, which evolved from the lectures of Austrian philosopher Rudolf Steiner in 1924, incorporates principles of oriental philosophy and astronomy.

Almost all of the produce leave the farm with value addition. About 70% of the harvest goes to the export market. It has received certificates from Demeter International, LACON Germany and Halal India. “At present, farmers suffer about 35% post-harvest loss. This can be considerably brought down by processing and value addition,” said R. Chandrasekaran, the other promoter.

Mariculture is as important for India as agriculture

About 37% of the area of the entire world is agricultural land, a third of which (about 11%) is used for crops. And as the population of the world rises to 9.7 billion people in 30 years, the land available for crops will reduce. Thus, there is an immediate need to try and improve the efficiency of food production. Experts predict that agricultural yield must increase by 50% between now and 2050. How to do this is the question facing agricultural scientists across the world.

Plants use sunlight to produce energy for their metabolism and food production. This is referred to as photosynthesis (wherein sunlight is used to make energy-rich molecules needed for producing food molecules). However, the efficiency of photosynthesis is rather low, just about 5% in most land crops. The most efficient land crop with 8% average is sugarcane, which is not all that edible,

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except for the sugar in it. If only we can increase the efficiency of crops such as wheat, rice and other grains!

One such attempt is through the project RIPE (Realizing Increased Photosynthetic Efficiency), undertaken by a group of scientists at the University of Illinois at Urbana-Champaign in the US, supported by the Bill and Melinda Gates Foundation (for some details, access Katherine Bourzac, in MIT Technology Review, August 14, 2017 issue).

Genetic engineering

One way of achieving it has been shown in the model plant tobacco where the scientists could “engineer photosynthesis” by increasing the expression of three genes involved in processing light. This increases the tobacco yield by 20%. The team is trying to do the same genetic engineering method in other plants. One such plant is cassava (also called tapioca, sago or sabudana) whose roots are carbohydrate-rich , and eaten by over half a billion people in Latin America and parts of Africa; indeed it is eaten as staple food in parts of Andhra, Kerala and the hilly areas of Assam. Genetic engineering of this plant was done, just as in tobacco, and appears to work.

Another way that some other scientists are trying is to reduce what is called photorespiration in plants. Here the energy and oxygen produced in the ‘light reaction’ of photosynthesis is drained by the plant to make “wasteful” products in the ‘dark reaction’, and not just carbohydrates and other food material, particularly when the plant’s leaves close in order to reduce water loss by evaporation. If we can find ways to reduce this photorespiration, edible food yields can go up.

Many of these research attempts involve the introduction of external genes and gene products into food crops, and these are opposed by group of people who do not want genetic engineering and genetically modified plants. This is a curious situation where science finds ways to deal with genes so as to

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improve yields while sociology opposes it based on worries about safety, as well as monopolistic control of food material through exclusive patents and other factors. A via media solution needs to be found, failing which food production may not increase all to feed the ever growing population of the world.

Include seaweeds in our diet

It is in this context that we need to open our minds and expand our ideas about our food habits. The most efficient use of photosynthesis is actually not by land plants but by micro and macro algae, such as seaweeds. These are the champions, contributing to about 50% of all photosynthesis in the world. And many of them, notably those with dark green, red and brown colour, are edible. They are low-calorie and nutrient-dense food items and eaten by people in most parts of South East Asia – Philippines, Malaysia, Vietnam, Indonesia, China, Korea and Japan, and also in some in coastal Atlantic region. A site called “The definitive guide to edible seaweed” (foodrepublic.com) gives the details about several of these food items.

Seaweed research

About 844 seaweed species are reported from India, a country with a coast line of 7,500 km. Peninsular India from Gujarat all way to Odisha and West Bengal has a coast line of 5,200 km, and Andaman and Nicobar together have a coast line of 2,500 km. Thus, while we have 63% of our land area for crop agriculture, we should not forget this vast coastal area, much of which breeds seaweeds. Research in the area of edible seaweeds in India has been going on for over 40 years.

The Central Salt and Marine Chemicals Research Institute (CSMCRI) at Bhavnagar, Gujarat has done pioneering work in the area. Dr Amitava Das, its Director, tells us that over 20 scientists there have been involved for decades in research and propagation of seaweeds as potential of foods for people,

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as well as for isolating important chemicals of technological importance and crop biostimulant purposes.

Professor CRK Reddy, who was at CSMCRI for decades and currently at the Institute for Chemical Technology, Mumbai, has been an active advocate of seaweeds as food.

He points out that among the seaweeds found in plenty, Ulva, Pyropia, Porphyra and Kappaphycus are edible and that it will be good to cultivate them in large scale, as is done in countries like Japan. And Dr ArockiarajJohnbosco points out (Times of India, 12-1-2016) that, of the 306 seaweeds in the Gulf of Mannar, 252 are edible. Thus India should embark on Mariculture as vigorously as Agriculture, given its 7,500 km-long coastal line. Further, it does not require pesticides, fertilizers and water for irrigation, which is an added advantage.

Seaweeds are rich sources of vitamins A and C, and minerals such as Ca, Mg, Zn, Se and Fe. They also have a high level of vegetable proteins and omega 3 and 6 fatty acids. Best of all, they are vegetarian, indeed vegan, and do not have any fishy smell, thus good and acceptable. For all for those who worry about this "new" introduction, let us recall that India took quickly to imports like potatoes, tea and most recently to soyabean.

Professor Reddy has suggested that we may "break in" through the use of seaweeds as pizza seasoning, in spice sachets, so that people get used to them. After all, if the entire Eastern Asian population eats them, why not we from South Asia?

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'Policies biased against rainfed agriculture'

Three out of five farmers in India grow their crops using rainwater, instead of irrigation. However, per hectare government investment on their lands may be 20 times lower, procurement of their crops is a fraction of major irrigated

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land crops, and many of the flagship agriculture schemes are not tailored to benefit them.

A new rainfed agriculture atlas released this week not only maps the agro biodiversity and socio-economic conditions prevailing in such areas, but also attempts to document the policy biases that are making farming unviable for many in these areas.

There has been “negligence” toward rainfed areas, which is leading to lower incomes for farmers in these regions, admitted Ashok Dalwai, CEO of the National Rainfed Area Authority. He also heads the government’s Committee on Doubling of Farmers’ Income.

Speaking on the sidelines of a conference on revitalising agriculture in rainfed areas, he said farmers in such areas are receiving 40% less of their income from agriculture in comparison to those in irrigated areas.

Sabyasachi Das, coordinator of the Revitalising Rainfed Agriculture Network, which published the atlas, laid out the stark differences in government policy and expenditure.

“Lands irrigated through big dams and canal networks get a per hectare investment of Rs. 5 lakh. Watershed management spending in rainfed lands is only Rs. 18,000-25,000,” he said, adding that the difference in yield is not proportionate to the difference in investment.

“When it comes to procurement, over the decade between 2001-02 and 2011-12, the government spent Rs. 5.4 lakh crore on wheat and rice. Coarse cereals, which are grown in rainfed areas, only had Rs. 3,200 crore worth of procurement in the same period.”

It’s not just the quantum, but also the nature of investment that needs to change, he added.

Flagship government schemes, such as seed and fertiliser subsidies and soil health cards, are designed for irrigated areas and simply extended to rainfed

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farmers without taking their needs into consideration, said Dr. Das.

'No system'

For example, many hybrid seeds notified by the government scheme need plenty of water, fertilizer and pesticides to give high yields and are thus not useful to most rainfed farmers. Commercial fertilizers will simply burn out the soil without sufficient water. "The government has no system to channelise indigenous seeds or subsidise organic manure in the same way," he claimed.

Dr. Dalwai agreed that a more balanced approach was needed to give rainfed farmers the same research and technology focus and production support that their counterparts in irrigation areas have received over the last few decades.

Incubating agro forestry models — an idea blooms

The AadhimalaiPazhangudiyinar Producer Company at Kotagiri is a farmer-producer firm with 1,609 tribal people from the Nilgiris region as its shareholders.

Started in 2013 and incubated by Keystone Foundation, this company currently has four production centres and runs four retail outlets. It sells non-timber forest produce such as honey, amla and coconut, and value-added products, including coffee and pickles, candies, and textiles, all grown or produced by the tribal people. These are sold in bulk to traders and in the retail market.

Expansion plans

"We are looking at business development. We want to expand to cities, probably to Bengaluru first, and increase production. But, all the six directors of the company are tribal people and cannot bring in much investment. Financial institutions will not support us as we do not have assets. All the machinery that we have are given by government agencies or organisations.

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We are heavily dependent on government support," says A. Sudhir, CEO. Hence, when the company learnt about the Agroforestry Business Incubation Forum project, which is to be inaugurated at Mettupalayam on February 19, it joined the forum as a member. The incubation facility would have the machinery that the company needs. "We can use the machinery for a fee and need not invest in equipment. The logistics cost will not be high as the facility is at Mettupalayam. We can increase production and in turn, our procurement of produce from the tribals will go up," he adds.

The company is one of the 20-plus members enrolled so far with the project. The facility has been set up by the Forest College and Research Institute of Tamil Nadu Agricultural University on its premises at Mettupalayam with Rs. 2.4 crore financial support from the Entrepreneurship Development and Innovation Institute. The agro forestry business incubation centre is said to be the first-of-its-kind in India. "Agro forestry is an emerging industry with big time opportunities," says AnandanRamasami, CEO of the Forum.

The centre's aim is to develop entrepreneurship in agro forestry and create business opportunities. It will have a lab and machinery to produce value-added items, equipment to develop products on a pilot scale and a training centre. It will accommodate 20-50 incubatees at a time with an incubation period of about two years.

Farmers in Amaravati go on hunger strike over 'dry land' classification

The farmers of Abbarajupalem village in Amaravati are up in arms against the Capital Region Development Authority (CRDA).

They have launched a hunger strike opposing its refusal to revoke land classification from dry (metta) to wet (jareebu) which they parted with under the Land Pooling Scheme (LPS) without "any prior intimation." The condition of one of the farmers, KancharlaBalachandra Rao, 64, who is on hunger

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strike, is said to be “critical” .

The farmers are agitated over the alleged indifferent attitude of the State government too.

They allege that none of the higher-ups had turned up though they had been on the hunger strike for the last six days.

The CRDA, the farmers said, had changed the classification of their lands from ‘jareebu’ (highly fertile) to metta (dryland) after three years of handing over the land to it. It paid the annuity of Rs. 50,000 per acre considering that their land fell under the jareebu category. The farmers were assured that they would get 1,450 square yards per acre in return.

GummadiVenkateswara Rao, a farmer, said the CRDA had not taken their objections into consideration. The farmers were wondering how the land classification had changed overnight when the government had been paying the jareerbu annuity for three years.

The authorities even set aside the High Court order to look into the issue raised by the farmers. Thirteen farmers, who were at the receiving end due to the CRDA’s decision, were small and marginal holding one to one and a half acres.

“Mr. Balachandra Rao’s health is deteriorating. He has been on the hunger strike for the last four days. Yet, the authorities haven’t responded,” he said.

CPI(M) pledges support

Amaravati division CPI(M) secretary Ravi said the government had cheated the farmers and the party would stand by them until justice was done to them.

When contacted, CRDA Commissioner Ch. Sridhar said, “As per the directives, the Collector has appointed a multi-disciplinary expert team which will be submitting the report to him.” Under the LPS, the farmers gave their land as the government had promised 1,000 square yards of residential plot

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and 450 square yards of commercial plot for every acre of Jareebu land. For dry land, 1,000 square yards of residential plot and 250 square yards of commercial plot was promised. In addition, the annuity was being paid to the farmers.

Drought less probable this year: Skymet

There's unlikely to be a drought in 2019 as the El Nino — a climate phenomenon linked to poor monsoon in India — is likely to peter out by the beginning of the season, according to a forecast by private weather forecaster Skymet.

"The El Nino conditions were on the rise in the Pacific Ocean till December last. The temperatures are now declining, and the probability of El Nino is also falling. This will reduce to about 50% by the time monsoon arrives with a gradual decline thereafter as well. This means it is going to be a devolving El Nino year," said Jatin Singh, managing director, Skymet Weather.

An El Nino refers to a half-to-one-degree rise in temperatures in the Central equatorial Pacific and is linked to a reduction in rains over key monsoon belts.

Earlier this month, the U.S. National Climate Centre issued a forecast that an El Nino had formed, was likely to persist until spring but there was only a 50% chance that it would persist beyond spring (March-April). "Because forecasts through the spring tend to be more uncertain and/or less accurate, the predicted chance that El Nino will persist beyond spring is 50% or less…" the climate centre's statement noted.

Skymet defines 'normal rains' as that in a 4% window of 88 cm between June and September; 88 cm means '100%' rainfall. Anything from 90% to 96% of the normal is 'below normal' and less than 90% constitutes a drought. Mr. Singh said that while the chances of a normal monsoon were the highest, about 50%, the next highest odds were those of 'below normal' rains.

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'Not formal forecast'

Skymet's estimate doesn't constitute a formal monsoon forecast, Mr. Singh clarified. However the organisation's weather models as well as those of several other institutes, for now, agreed that the odds of a major El Nino (a temperature rise greater than a degree) were unlikely. "So we're confident on that front but a fuller forecast can only be made, at the earliest, by April," Mr. Singh told The Hindu.

The India Meteorological Department (IMD) too concurred that a strong El Nino is unlikely but said it's too early to rule out a drought. "The way we compute…we need weather conditions until March 30 to input into our models and only then we get a sense of the monsoon. However, the odds of a strong El Nino are low," said K.J. Ramesh, Director-General, IMD.

Topical gel protects farmers from pesticides

Using easily available, inexpensive natural polymers, researchers in Bengaluru have developed a gel for the skin to protect agricultural workers from harmful pesticide sprays. The gel does not just act as a simple physical barrier; it chemically deactivates pesticides.

Ripple effect

Organophosphate pesticides bring about the inhibition of important enzymes (AChE) of the body, which can, in turn, affect the functioning of nervous system, heart, immunity, and even the reproductive system.

Explains Ketan Thorat, a doctoral scholar at the Institute for Stem Cell Science and Regenerative Medicine (inStem), Bengaluru, "The base of the gel is chitosan, a natural substance extracted from the waste shells of crabs and shrimps, to which we added a nucleophile and few aqua reagents to get the consistency and desired pH."

Dr. Thorat, who is also the first author of a paper on the subject published in Science Advances, adds, "The gel looks and feels like a cold cream and we

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can add suitable fragrance too."

Since pesticides can inhibit enzymes in blood, different experiments were carried out using rat blood to see if the gel could prevent this. The gel was found to cleave a wide range of commercially available pesticides before they enter the bloodstream, thus reducing the pesticide-induced enzyme inhibition.

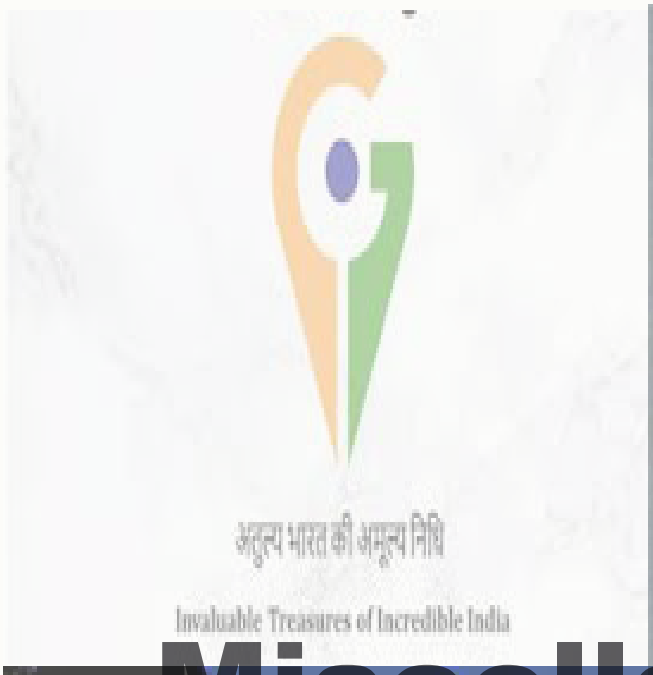
In-vivo studies were carried out using rat models. Even 96 hours after pesticide exposure, the gel-applied rats did not show any reduction in enzyme activity. The control animals (without gel) exposed to pesticides lost about 20% of their body weight by four days, whereas the protected rats had normal weight.

To understand pesticide-induced mortality, the researchers sprayed a higher concentration of pesticide on the rats for four consecutive days and monitored them. The rats without the gel showed signs of pesticide poisoning such as diarrhoea, trouble in breathing, tremors and died after five days. All the rats in the protected group survived and showed no signs of toxicity even after 30 days.

Post-mortem studies showed that the rats had decreased levels of the important enzyme in their system.

Safe to use

Explains Dr. Praveen K. Vemula, from inStem, and corresponding author of the paper, "We carried out pre-clinical toxicology studies and the gel was found to be safe for repeated applications. It had no side-effects even if inhaled, swallowed or if it comes in contact with the eye." According to Dr. Vemula, when produced in bulk, the gel may cost less than Rs. 1,000 for an entire month.



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Scientists unearth Asia's first fossil Dioscorea yam leaf

Speak of fossils, and dinosaurs first come to mind. A quaint fossilised leaf is one of the most recent finds throwing light on India's past. The leaf fossil is the first of Dioscorea yams from Asia and hints at a Gondwanan origin to these plants, claim scientists.

When scientists R. C. Mehrotra and Anumeha Shukla from Lucknow's Birbal Sahni Institute of Palaeosciences were leading a dig in the Eocene-era (38-56 million years ago) Gurha lignite mine in Bikaner in western Rajasthan, they obtained two well-preserved fossils of large leaves. "They are about 16 cm long," wrote co-author Dr. Shukla in an email.

Referring to herbarium sheets available at Dehradun's Forest Research Institute, the team identified it as a species of Dioscorea, a kind of yam that grows as a herbaceous vine in the humid tropics of India and other countries. They also used the morphological features of the leaves — venation and leaf shape — to rule out other plants that look very similar to it. When they compared it to the other Dioscorea fossils obtained from Europe, Africa and America, they found it to be very distinct.

Tropical forests

The team named their new find Dioscoreaeocenicus: the first ever Dioscorea fossil recorded from Asia. Currently, species of Dioscorea in India are found in the humid, tropical forests of the country. Based on this, the team infer that such tropical forests must have flourished in this part of Rajasthan during early Eocene. Other fossil plants observed in the mine also suggest this historical climate in the area, which is now dry and consists of desert vegetation.

So what caused such a drastic change in climate? As the Indian subcontinent broke away from the supercontinent Gondwanaland many millions of years ago and drifted towards the Equator, the resulting tropical weather created lush tropical forests here. As the landmass moved further north and away

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from the equator, dry vegetation replaced these forests, write the authors. Further, based on the location of other Dioscorea fossils across the world (from continents that used to be part of Gondwanaland) and the current pan-tropical distribution of Dioscorea species across the world, the scientists suggest in their study published in Review of Palaeobotany and Palynology that Dioscorea plants could be of Gondwanan origin. However, more fossil records would be required to confirm this, added Dr. Shukla.

'Plastic waste imports to India go up'

In spite of a ban on the import of plastic waste into India, the influx of PET bottles has quadrupled from 2017 to 2018 thanks to legal loophole, says a Delhi-based environmentalist organisation, Pandit Deendayal Upadhyay Smriti Manch (PDUSM).

"Indian firms are importing plastic scraps from China, Italy, Japan and Malawi for recycling and the imports of PET bottle scrap & flakes has increased from 12,000 tonnes in FY 16-17 to 48,000 tonnes in FY 17-18 growing @ 290%. India has already imported 25,000 MT in the first 3 months of FY 18-19," says a note by the organisation.

Wide gap

Government and industry estimates suggest that India consumes about 13 million tonnes of plastic and recycles only about 4 million tonnes.

A lack of an efficient waste segregation system and inadequate collection is the root cause, according to experts, for much of the plastic not making its way to recycling centres.

To incentivise domestic plastic recycling units, the government had banned the import of plastic waste, particularly PET bottles in 2015. In 2016, an amendment allowed such imports as long as they were carried out by agencies situated in Special Economic Zones. It's this loophole that's been

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exploited.

A senior Union environment ministry official, who declined to be identified, told The Hindu that while the ministry couldn't vouch for whether such plastic imports had quadrupled, it was true that the imports had "substantially increased" and action was being contemplated. "We've been apprised of these imports and they're quite substantial. We're beginning internal investigations to see how this can be addressed," the official added.

Ravi Agrawal, director of Toxics Link, an organisation that works on plastic waste management, said that figures were "plausible" as China, once a major global importer of plastic waste for recycling, had banned such imports.

"It's possible that some of that is making its way to India but I can't be sure of these numbers," Mr. Agrawal said.

18 Indian institutions to study nitrogen pollution

Eighteen research institutions in India are among a group of 50 institutions — called the South Asian Nitrogen Hub (SANH) — in the United Kingdom and South Asia that have secured £20 million (about Rs. 200 crore) from the U.K. government to assess and study the quantum and impact of "nitrogen pollution" in South Asia.

While nitrogen is the dominant gas in the atmosphere, it is inert and doesn't react. However, when it is released as part of compounds from agriculture, sewage and biological waste, nitrogen is considered "reactive", and it may be polluting and even exert a potent greenhouse gas (heat trapping) effect.

"So far, we have focussed on carbon dioxide and its impact on global warming. Nitrous oxide (N_2O) is 300 times more potent than carbon dioxide but isn't as prevalent in the atmosphere. However, this is poised to grow," said N. Raghuram, Chairman, International Nitrogen Initiative (INI) and Professor of Biotechnology at Guru Gobind Singh Indraprastha University, New Delhi.

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"In the future, reactive nitrogen pollution will be a matter of significant global discussion and, unlike carbon, India and South Asia cannot wake up at the last minute, realising that it has no updated, scientific assessment of its inventory."

Last year, Dr. Raghuram led a consortium of researchers who assessed trends in nitrogen emissions in India, where NOx emissions grew at 52% from 1991 to 2001 and 69% from 2001 to 2011. The SANH will study the impacts of the different forms of pollution to form a "coherent picture" of the nitrogen cycle. In particular, it will look at nitrogen in agriculture in eight countries — India, Pakistan, Bangladesh, Nepal, Afghanistan, Sri Lanka, Bhutan and Maldives.

When did modern science emerge in India?

Considerable debate and discussion have been going on in recent weeks about the practice of technology and science in India from ancient times to today. Sadly enough, some people have attempted to interpret mythological events in terms of the discoveries and inventions of today's science, thus claiming that they existed already centuries ago. In this context, a historian has rightly pointed out that the history of science in India must be treated as a serious subject rather than a matter of speculation (A. Ramnath, The Hindu, 15 January 2019). He quotes the historian David Arnold who cautioned that while the sages of antiquity may have had ideas compatible with the atomic theory of matter, their "felicitous intuition" was a step removed from the modern scientific method which relies on sophisticated instruments.

This seems to have been the practice not just in India but elsewhere in the world of those days. Now, "modern science" or the Baconian method (Francis Bacon, English philosopher 1561-1626) of inductive reasoning, careful observations and skeptical analysis of results has come to stay. The method of modern science involves: "ask a question or have a theory, do careful

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experiments/observations, interpret the results, conclude rationally, have it repeated and tested by others, and if it is confirmed by others, your theory is right. Note that if at a later date, this theory or law does not fit new facts and discoveries, your theory may need modification or even rejection".

European explorers

This "modern scientific method" started to emerge in India in the late 1490s as European explorers such as Vasco de Gama, John Cabot, Ferdinand Magellan and others came over to the "East Indies." This was quickly followed by traders and explorers from England, France and some other parts of Europe. Many of them, traders and capitalists, had to "discover India" and its environs, wealth and health, metals and minerals, began exploiting them for colonial gains. In order to do so, they used scientific methods. In addition, several of them who practised contemporary science, technology, agriculture and medicine spread such knowledge to the "natives."

This has been the emergence of modern science in Colonial India. A thematic issue with this title has just been published by the Indian Journal of History of Science in its December 2018 issue (it is available free on the web (at https://insa.nic.in, go to Journals, click at Indian Journal of History of Science,Volume 53 , Year 2018, Issue 4, and go to your article of interest).

This issue has been guest edited by Prof. Arnab Rai Choudhuri, a physicist from IISc Bengaluru and Prof. Deepak Kumar of JNU. Prof. Rai Chaudhuri is also a science historian and his incisive analysis, "On practising western science outside the West: personal observations on the Indian scene" which appeared in the 1985 August issue of the journal Social Studies of Science is even more relevant today. And Prof. Deepak Kumar, a renowned historian from JNU, has written authoritatively on "Science and the Raj" (OUP, edn 2, 2006) and "Technology and the Raj" (SAGE 1995) on the history of science in India.

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The editorial of the issue by Dr. A.K. Bag, a well known historian of both ancient and modern science in India, tracing the Indo- European encounter and features of modern science in pre-colonial and colonial India, is scholarly, exhaustive and very instructive. The issue has 30 other articles covering how the Bengal Renaissance and the erstwhile capital of British India in Calcutta helped make Bengal (Calcutta/Dacca) the early capital of modern science in India. While J.C. Bose , C.V. Raman , S.N. Bose, P.C. Ray and MeghnadSaha are covered, Dr. Rajinder Singh goes beyond the "Big Three" (C.V. Raman, S.N. Bose and M.N. Saha), and writes about Professors B.B. Ray, D.M. Bose and S.C. Mitra. The piece by Dr. John Mathew: "Ronald Ross to U.N. Brahmachari: Medical Research in Colonial India" talks about how Prof. Brahamachari's drug "urea stibamine" saved thousands of lives from the parasitic disease Kala Azar. Incidentally, Brahmachari talked about this in his Presidential Address in 1936 at the 23rd session of the Indian Science Congress at Indore. And the article on "Organic chemists of pre-independence India: with spend focus on natural products" makes special mention of a remarkable polymath, Prof. Salimuzzaman Siddiqui, who isolated important drugs such as reserpine from sarpagandha and azadirachtin from the neem tree. When Partition came and he was requested to come to Pakistan, he first refused and then went in 1951 where he helped start the CSIR and the Atomic Energy labs of Pakistan, and an excellent organic chemistry which is still carrying on excellent work. He may thus be regarded as the one who laid the foundations of science and technology in the nascent country, Pakistan.

Forgotten pioneers

Three other contributors are worth nothing; one of them by Sodhi and Kaur on "The forgotten pioneers of fingerprint science: fallout of colonialism," talks about two Indian police officers, Azizul Haque and Hem Chandra Bose. While these two subordinates did the hard work and quantified fingerprinting using analytical pattern method, their boss Inspector General of Police Edward

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Henry took the credit! Haque represented 5 years later to the Governor he was given an honorarium of Rs5,000 and Bose Rs10,000.

The second is about Nain Singh Rawat who travelled all the way from the Tajikistan Border of the Himalayas down the entire Himalayan track, took careful notes and helped prepare the Upper Road Map in the late 1800s. This helped the Survey of India later.

And the third is that of RadhanathSikdar of Calcutta who discovered through his computation that Peak XV was 29,029 feet high, thus making it the highest in Himalayas and thus the world. However, it was named Mount Everest, after his head officer at the Topographical Survey of India. Dr Bag in his editorial mentions these two discoveries and how the government of India issued a commemorative postage stamp in honour of Rawat and Sikdar on June 27, 2004.

While we have highlighted only some articles from the journal, the entire issue is a collection of carefully researched, compactly written and easily readable articles on the birth and growth of modern science in India and would be an ideal teaching and research material in science education.

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History of India's last known hippo

Nearly 5.9 million to 9,000 years ago, India was home to the hippopotamus. These entered Eurasia from Africa, then diversified in South Asia before going extinct.

Now, studying a small fragmented tooth unearthed in Madhya Pradesh, an international team of researchers has discovered the last known specimen of the Hippo Hexaprotodon species. However, this does not mean that it is the last one to have lived in India.

This fossil was unearthed in 2003 by Rajeev Patnaik (Panjab University) and Parth R. Chauhan (IISER Mohali) who spent days studying the fossiliferous

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silt near the river Narmada. “We believed that the species was older than 50,000 years and did not study it fully. Recently, I analysed the date using accelerator mass spectroscopy (AMS) in Taiwan. It revealed that the specimen was quite young and could possibly be among the last ones that lived in India,” Dr. Patnaik says. Accelerator mass spectroscopy does not require a large sample and it also has a higher precision than traditional radiocarbon dating.

The paper published in Quaternary International also discusses the possible causes of the extinction. The researchers hypothesise that a “combination of climatic stress and anthropogenic impacts” could have led to their extinction.

Dating studies show that this hippo lived during a “particularly dry period in the late Quaternary” period (15,000-16,000 years ago). Severe drought in South Asia and weak Indian monsoons might have led to the extinction.

Researchers note that hunting, habitat alteration, ecological human encroachment were the reasons for species extinctions during this period in other parts of the world. While Hexaprotodon and Homo sapiens co-existed for several thousand years, researchers did not find any kill sites, but they note that this reason cannot be ruled out.

Direct dating

This is the only directly dated Hexaprotodon from the Indian subcontinent, the report states. “A direct date means that the fossil bone of the animal was used to determine the date. Usually, charcoal or shells found alongside the fossil are studied and this known as an indirect or associated date,” explains Advait M. Jukar, the paper’s lead author, in an email to The Hindu. He is from the Department of Paleobiology, National Museum of Natural History, Smithsonian Institution.

He explains that carbon isotope analysis showed that the animal had a C4

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dominated diet. “It refers to the kinds of plants the animal was eating. The plants leave a specific isotopic signature in the teeth of animals that eat them... basically, these hippos were eating grasses, and grasses prefer dry, seasonal climates.”

The report concludes that ancient DNA could provide insights into the causes of the extinction. When asked if fossils hold DNA, Advait explained, “DNA does degenerate as soon as the animal dies, but fragments remain, and in some cases, have been isolated from fossils that are a few hundred thousand years old. This Hexaprotodon specimen isn’t very old, so it may be possible to extract DNA fragments.”

How the fruit fly experiences bitter taste

Deciphering how the fruit fly brain works has been a significant branch of study in the biological sciences for several decades now. In this, a team of researchers from National Centre for Biological Sciences, Tata Institute for Fundamental Research, Bengaluru (NCBS-TIFR), have figured out the neuronal circuitry that is involved in processing bitter taste.

Interneurons

While the neurons that sense the bitter taste have been identified, as have the motor neurons that innervate the physical reactions to having sensed bitter taste, the intermediate circuitry has remained unknown. In a collaborative work with researchers from University of California, Berkeley, USA, and University of Basel, Switzerland, the NCBS-TIFR team have identified a single pair of interneurons that are responsible for connecting the sensory and motor neurons involved in bitter taste processing. The work is published in Current Biology.

To identify these interneurons, genetic and imaging approaches are used. “We genetically activated and inactivated particular neurons to identify their

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role in bitter taste behavior. We then used imaging tools to record the activity of these neurons," says Ali Asgar Bohra, the first author of the paper, then a PhD student at NCBS-TIFR.

Partly the reason for the interest in the workings of the Drosophila (fruit fly) brain is because it is a good proxy to approach the goal of knowing how the human brain itself works. There is also another reason: "Studying the bitter taste circuit helps in understanding how insecticides and pesticides work to repel insects," says Dr Bohra, who is now a research associate with King's College, London, in an email to The Hindu.

The reactions of fruit fly to bitter and sweet tasting material differ significantly. When it senses food cues, mainly sweet tasting, through the sensory neurons in its legs, or proboscis, it extends its proboscis for consuming the food. "If a fly senses a bitter, toxic or noxious substance, it won't extend its proboscis," explains Dr Bohra. "I used this assay [test] to screen and identify the neurons which are involved in bitter taste processing." The team also used the live imaging technique developed by Benjamin R. Kallman, the collaborator in UC, Berkeley, to record the activity of the brain in live animals.

They plan to take forward the research, "by trying to identify the remaining neuronal type… thus completing the neural circuit for bitter taste. This will help understand the role of different neurons and molecules (present in the brain) in sensory information processing and behaviour," he says.

MISCELLANEOUS

Urbanisation of Tirunelveli city might warm it up

This is one ten-year-challenge that city planners need to take note of: Tamil Nadu's Tirunelveli city now has less vegetation and more urban areas, all in just one decade. This could create an 'urban heat island' — urban area that is significantly warmer than its surrounding rural areas — finds a study.

Green vegetation and water bodies are often lost as built-up areas in a city

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increase. Radiation from cemented floors, roads and buildings add to the temperature. This leads to a surge in surface and air temperatures, causing urban heat islands (UHIs) to form. According to Rajchandar Padmanaban, scientist at Portugal's NOVA Information Management School, this is common in fast-growing cities in developing countries. Padmanaban and his colleagues including Avit Bhowmik (Royal Swedish Academy of Sciences, Sweden) investigated the environmental and climatological impacts of such unprecedented urbanisation in Tirunelveli, which has seen rapid population growth over the last two decades due to immigration of people.

To do this, the team fused satellite images of the city from multiple satellite sensors — a method usually used in remote sensing but rarely to model the emergence of urban heat islands. This however, gave them a higher accuracy in their results.

The team's results, published in PLOS ONE, show that the city has undergone rapid urbanisation (at an average rate of 4% between 2007 and 2017), with a 32% increase in the coverage of urban built-up area. Fertile cropland pastures (which show a decline of almost 60% in the city) have been converted to fallow lands (mostly real-estate plots, which have increased by a whopping 178%). Fallow lands have, in turn, been transformed into built-up areas. This was most prominent in the western riverine stretch of the city, where the Thamiraparani river flows by. Forested areas in the northeastern part decreased by 12% while the bush and shrubbery-covered infertile areas increased by 164% throughout the city.

The team's land surface temperature assessments from the maps revealed a high potential for the emergence of UHIs in Tirunelveli. The highest areas at risk of this are the western riverine zone (which showed a loss of greenery) and eastern and southeastern Tirunelveli. The southeastern portion could be a potential UHI hotspot, the scientists add.

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According to the authors, proper zonal planning that accommodates sufficient green spaces (such as urban greenery and water bodies) can prevent the emergence of more UHIs in future.

"Smart and energy-efficient construction materials and green roofs may also substantially help prevent the emergences of urban heat islands," wrote Dr. Bhowmik in an email.

Check your compass: The magnetic north pole is on the move

Earth's north magnetic pole has been drifting so fast in the last few decades that scientists say that past estimates are no longer accurate enough for precise navigation. , they released an update of where magnetic north really was, nearly a year ahead of schedule.

The magnetic north pole is wandering about 34 miles (55 kilometres) a year. It crossed the International Date Line in 2017, and is leaving the Canadian Arctic on its way to Siberia.

The constant shift is a problem for compasses in smartphones and some consumer electronics. Airplanes and boats also rely on magnetic north, usually as backup navigation, said University of Colorado geophysicist Arnaud Chulliat, lead author of the newly issued World Magnetic Model. GPS isn't affected because it's satellite-based.

The military depends on where magnetic north is for navigation and parachute drops, while NASA, the Federal Aviation Administration and US Forest Service also use it. Airport runway names are based on their direction toward magnetic north and their names change when the poles moved. For example, the airport in Fairbanks, Alaska, renamed a runway 1L-19R to 2L-20R in 2009.

The US National Oceanic and Atmospheric Administration and United Kingdom tend to update the location of the magnetic north pole every five

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years in December, but this update came early because of the pole's faster movement.

The movement of the magnetic north pole "is pretty fast," Chulliat said.

Since 1831 when it was first measured in the Canadian Arctic it has moved about 1,400 miles (2300 kilometres) toward Siberia. Its speed jumped from about 9 miles per year (15 kilometres per year) to 34 miles per year (55 kilometres per year) since 2000.

The reason is turbulence in Earth's liquid outer core. There is a hot liquid ocean of iron and nickel in the planet's core where the motion generates an electric field, said University of Maryland geophysicist Daniel Lathrop, who wasn't part of the team monitoring the magnetic north pole.

"It has changes akin to weather," Lathrop said. "We might just call it magnetic weather."

The magnetic South Pole is moving far slower than the north.

In general Earth's magnetic field is getting weaker, leading scientists to say that it will eventually flip, where north and south pole changes polarity, like a bar magnet flipping over. It has happened numerous times in Earth's past, but not in the last 780,000 years.

"It's not a question of if it's going to reverse, the question is when it's going to reverse," Lathrop said.

When it reverses, it won't be like a coin flip, but take 1,000 or more years, experts said.

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The Table that defines chemistry turns 150

The majestic table of elements that hangs on the walls of chemistry classrooms across the world has turned 150 years old in 2019.

The 'Periodic Table of Elements', or simply, 'The Table' for many, was written by Dmitri Ivanovich Mendeleev on 17th February 1869. Looking back,

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the Table opens a window to the world of inanimate matter. Mendeleev's profound impact on chemistry is comparable to those of his contemporaries, Gregor Mendel and Charles Darwin in genetics and evolution, respectively. Therefore, the United Nations General Assembly and UNESCO have decided to celebrate 2019 as the "International Year of the Periodic Table of Chemical Elements (IYPT2019)".

Mendeleev was not the first one to create a table of elements. Earliest of such efforts was due to the father of modern chemistry, Antoine Lavoisier in 1789 who classified them in terms of their properties. John Newlands introduced the concept of octaves in chemistry, wherein properties repeat for every eighth element. There were other attempts too.

However, the proposal of Mendeleev was unique. On February 17, 1869 he sent out a single page note to the Russian Chemical society outlining his findings and it was published in the first volume of the society's journal. In the same year, its German abstract with a table and eight comments was published in ZeitschriftfürChemie, taking it to larger Europe.

Mendeleev's finding was that "The elements, if arranged according to their atomic weights, exhibit an evident stepwise variation of properties". In his Faraday Lecture, delivered in 1889 the statement of the periodic law appeared in the more familiar form: "The elements, if arranged according to their atomic weights, exhibit an evident periodicity of properties". While putting together all the 63 elements known at that time, his periodic table placed four slots between the known ones with question marks. He labeled them with a prefix, eka. All eka elements were discovered subsequently: eka-aluminum (gallium) in 1875; eka-boron (scandium) in 1879; eka-silicon (germanium) in 1886 and eka-manganese (technitium) in 1937. Periodic table predicted the properties such as metallicity, density, melting point, etc., of the eka elements. Today, all the 118 elements are put in the periodic table

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based on the periodic law.

Mendeleev put emphasis on chemical properties. As a result, in a few cases systematically increasing atomic weights did not match well with chemical properties. He hesitatingly placed tellurium before iodine with a question mark, although tellurium is heavier than iodine. Today we know that his placing was indeed justified.

Periodicity in properties made systematisation of information. Modern periodic law states that, "the properties of the elements are periodic functions of their atomic numbers." This restatement is due to Moseley who worked on the topic in 1913. Here, we must note that Mendeleev related the properties to atomic weights at a time when atomic numbers, or number of protons in the atomic nucleus was unknown. They were found to be part of nuclei in 1917 and the nucleus itself was discovered in 1911, both by Rutherford. In 1869, atomic weights were considered as the single most important property of elements.

Mendeleev had a compelling reason to discover the periodic table. He was deeply concerned about the prevailing systematization of chemical knowledge and decided to write textbooks (Principles of Chemistry, Vol. I & II). He could cover only eight elements in his first volume of the book, which was finished in January 1869 and wanted to condense information in the form of a table for the second volume. It is said that the first version of the Table appeared in his dream.

Intense passion of the man to study science should motivate anyone. He was the youngest of 17 siblings who lost his father at the age of 13 and saw the destruction of his mother's factory by fire. She took him across Russia, walking all the way from Siberia to Moscow, a distance of 3,500 km. Having denied a place in Moscow, they next went to St. Petersburg where Mendeleev joined the pedagogy course. After graduation and a few years of work, he returned to St. Petersburg for his Masters degree.

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The current periodic table decorating the walls of class rooms, printed on tea-cups, T-shirts and memorabilla is far removed from the original version of Mendeleev. Yet, the core principle that 'properties of elements are periodic functions of the inherent properties of its atoms' remain. This would indeed be one of the most fundamental insights into the puzzles of nature for which Mendeleev would be known for eternity. For that reason, element 101 is aptly named as Mendelevium (Md). Although narrowly missed the Nobel Prize of 1906, he became one of the 15 scientists to be remembered with an element, a more illustrious recognition considering that 181 have won a Nobel Prize in chemistry so far.

Indelible ink's new challenger: invisible ink

Indelible ink, the purple stain that billions of Indians show off during elections may face an invisible challenger in the near future. The Delhi-based National Physical Laboratory (NPL), the creator of indelible ink, has a new concoction that, when applied on the finger, doesn't leave a trace — it merely glows a bright orange when a low-intensity beam of ultraviolet light is shone on it.

The NPL prepared the 'invisible ink' as part of a pilot project mooted by the Mysore Paints and Varnish Ltd. (MVPL). "The MVPL discussed with us the development of such an ink for use by a client [country] in Europe," said Dinesh Aswal, director, NPL. The MVPL, a Karnataka government company, has a monopoly on the manufacture of indelible ink since 1962, and is a major supplier to the Election Commission of India (ECI). It also exports the indelible ink for elections in other countries. C. Hara Kumar, general manager, MVPL, said the 'invisible ink' was only at the discussion stage, and nothing had been firmed up.

The indelible ink was formulated as a deterrent against voting twice. But strangely enough, voters in some countries found the stained finger rather unseemly. "In India, we are proud to display our voter's ink, but apparently in

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some countries people don't want to display such a mark. So MVPL asked us if there was a solution," said Mr. Aswal.

Organic-inorganic mix

The NPL's invisible ink, however, wouldn't be of immediate use to the EC. "The current formulation can't be used for Indian elections as they are spread out over many weeks. We would need a different formulation," said Mr. Aswal. He described the chemical — a transparent liquid — as an "organic-inorganic" mixture that was biodegradable and could be washed off in 48 hours." The ink works on the well-known principle of fluorescence — certain materials emit a characteristic glow when exposed to ultraviolet light. The NPL ink, however, glows only when exposed to a narrow band of frequencies of ultraviolet (UV) light. "Commercial UV markers or inks respond to a very broad spectrum of UV light. So, along with the ink, we'll supply an inexpensive LED (costing no more than Rs. 30) that would emit a specific frequency of UV," said Mr. Aswal. The NPL's invisible ink experiment is linked to a larger project of creating security inks that could be used to make bank notes and documents, such as passports, more secure.

Is death by mosquito bite insurable?

Well, not if the mosquito bit the insured person in the Republic of Mozambique, the Supreme Court held in a judgment.

The case concerns Debhashis Bhattacharjee, who died of multiple organ failure after being diagnosed with encephalitis malaria contracted from a mosquito bite he sustained while working in Mozambique in 2012.

His insurance policy covered personal accidents. Both the State and the National Consumer Dipsutes Redressal Commissions dismissed the plea made by the insurance company, National Insurance Limited, that the man died as a result of an infection. The company argued that a mosquito bite

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cannot be classified as a 'personal accident' covered under the policy.

The insurance company, represented by advocate Madhavi Divan, said death due to malaria was a common occurrence in Mozambique. Ms. Divan referred to the World Health Organisation's World Malaria Report 2018, which showed that an estimated ten million cases of malaria in Mozambique and an estimated 14.7 thousand deaths in 2017.

A Bench led by Justice D.Y. Chandrachud disagreed with the conclusions of both the Consumer Disputes Commissions.

The National Commission too had agreed that if the insurance company could cover events like snake bite, frost bite and dog bite then why not mosquito bites.

In his 16-page judgment, Justice Chandrachud acknowledged that being "bitten by a mosquito is an unforeseen eventuality."

However, the mosquito bit Mr. Bhatacharjee in Mozambique, which according to World Health Organisation has a population of 29.6 million people and accounts for 5% of the cases of malaria globally.

"It is on record that one out of three people in Mozambique is afflicted with malaria. It was not a peril insured against in the policy of accident insurance," Justice Chandrachud said and set aside the decisions of the Consumer Disputes Commission.

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Nanomagnet assembly to make up efficient logic gate

A group at Indian Institute of Technology (IIT) Hyderabad has proposed a novel design methodology for constructing an adder logic gate using nanomagnets from magnetic quantum dot cellular automata. At a stage when conventional CMOS (Complementary metal oxide semiconductor) devices are approaching a saturation in terms of power efficiency, this comes as an effective step towards a complementary approach. AI applications such as

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speech and face recognition, used for instance in self-driving cars, require 3D cameras and real-time processing. These are computation-intensive and in dire need of efficient solutions. This technology is a complementary solution to CMOS devices in this, being both power efficient and non-volatile. In a paper published in IEEE Transactions in Nanotechnology, the group shows how modifying the shape and alignment of the nanomagnet assembly can improve earlier models of such adders.

Santhosh Sivasubramani, research scholar and the first author of the paper, explains the advantage: Power dissipation in CMOS logic circuits can be divided into dynamic and static dissipation. The former is caused by on-currents passing through the CMOS logic gates due to logic operations, and the latter by leakage currents in the CMOS gates even during standby mode in which no logical operations are executed. If the system is turned off, it loses its state data; however, in nanomagnetic computing, it possess the property of non-volatility. “Dramatic reductions in power consumption are possible in magnetic chips down to as little as one-millionth the amount of energy per operation used by transistors in modern computers,” he says.

Graphene

Initially, around year 2000, copper wires were used in the circuit along with the nanomagnets. However, the sizes of these wires were large compared with the nanomagnets. This group, under the leadership of Amit Acharyya from Department of Electrical Engineering, IIT Hyderabad, tried and succeeded in using graphene wires which circumvented this problem. “Now, to make the logic gates, we are proposing nanomagnets with special shape and alignment,” says Dr. Acharyya.

To obtain a MQCA (Magnetic Quantum-dot Cellular Automata) circuit that performs a logic operation, such as addition, normally three oval nanomagnets need to be used for input and one for output . Further, the input nanomagnets need to be driven by an external driver magnet.

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The two techniques the team advocates are using slant-edged nanomagnets (which are rectangular in shape but with a slant cut at one corner) and also those that are aligned at 45 degree angle with respect to the other nanomagnets used. This drastically reduces the number of nanomagnets needed and also the power consumption. “We already have undertaken the work on getting 32-bit and 64-bit adder circuits developed using this proposed concept so that larger circuits implementation will become feasible,” says Dr. Acharyya.

Camera traps reveal secret lives of rarely studied small cats

We know camera traps can help count tigers. Now, a team has used this technology to estimate activity patterns of some, rarely studied small cats of northeast India. Their findings suggest that factors other than inter-species competition could explain why some of these wild cats occur in the same area together.

Northeast India is home to nine wild cats, including the ‘standard four’: the clouded leopard, Asiatic golden cat, marbled cat and leopard cat. However, very little is known about these cats in this region at present, such as what times of the day they are most active or how they do not out-compete each other for resources despite living in the same ecosystem.

Standard four

A collaborative study by 14 researchers led by principal scientist Shomita Mukherjee (Salim Ali Centre for Ornithology and Natural History, Coimbatore) compiled information from ten independent camera trap studies to estimate the activity patterns of the ‘standard four’ in Assam, Arunachal Pradesh, Nagaland, Meghalaya and Mizoram. The team obtained 783 photo captures from around 27,500 trap nights (the total number of nights the camera traps were deployed) between 2013 and 2018. Based on the time that each photo was captured, they analysed their activity patterns.

Their results, published in the Journal of Threatened Taxa, reveal that all

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four cats occurred together only in three of the 10 sites surveyed. Analyses of activity patterns showed that Asiatic golden cats and marbled cats were strongly diurnal, the clouded leopard largely crepuscular and nocturnal, and the leopard cat mostly nocturnal. Like others across southeast Asia, this study also found that the activity times of the marbled cat and leopard cat did not overlap much, in areas where they occurred together and otherwise.

According to the authors, this suggests something other than inter-species competition could be at work here. Both cats could be utilising different niches (marbled cats have long tails that suggest arboreality so they could be catching arboreal prey, while leopard cats are known to feed primarily on ground prey, especially rodents), said Dr. Mukherjee.

"However, more detailed studies of several aspects including diet and activity would be required to confirm this," she said. The study also shows how data from already conducted camera trap studies can be used to learn more about other less-known species, she added.

Take a deep breath to be calm and alert

In college debate competitions, you had to respond to your opponent effectively and win, and do so in a short time. There was also this competition called 'Just a Minute' where the referee would ask you to talk about a topic that he chooses; you should talk about it for one minute – no hemming and hawing, no irrelevant words and no catching for breath. And the one who makes the most sensible speech in a minute wins.

In all this, our teacher or 'coach' would tell us: "take a deep breath before you start;it will improve your performance". That he was right has recently been confirmed by a study from a group of scientists, led by Professor Noam Sobel of the Weizmann Institute of Science, Israel, titled "Human non-olfactory cognition phase-locked with inhalation" (Perl et al., Nature

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Human Behaviour, 11 March 2019 <https://www.nature.com/articles/s41562-019-0556-z>. A nice 'popular' summary of this work has been presented by Dr. YivsamAzgad of the media relations group of Weizmann. In this paper, the authors compared performance within a group of volunteers where they presented cognitive tasks to them, concurrent with inhalation or exhalation. The tasks included mathematical puzzles, spatial visualisation problems (whether a 3- dimensional figure could exist in reality) and verbal tasks (whether the words shown on the screen were real).The experiment was designed in such a manner that the subjects were not aware that their inhalation of breath was being monitored. And at the same time, the electrical activity to each of their brains was monitored using EEG (electroencephalograms).

The 'sniffing' brain

Three points of note came out of the trial. First, they found that in trials where the participants inhaled while attempting the task they did better than when they exhaled. Second, whether one inhales through the nose or the mouth, it did not matter much, though 'the picture-perfect' pattern would prefer nasal over oral breathing in. Third, the EEG results also showed altered patterns of connectivity between different parts of the brain which differed along the respiratory cycle.

Note that as we inhale, we take up oxygen from the air. So, is it the oxygen that they inhaled which helped? When asked, Professor Sobel said: "No; the time frame does not fit. The response time was far sooner than the time it takes for oxygen from the lungs to reach the brain... It is not only the olfactory system that is sensitive to inhalation and exhalation, it is the entire brain. We think that we could generalise and say that the brain works better with inhalation…We think of this as the "sniffing brain".

Most ancient sense

The paper also points out that the sniff alone — no odourants — orchestrates

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neural activity; thus it is not necessarily good or pleasant smell versus bad smell. The group hypothesises that nasal inhalation, apart from processing incoming information, also optimises non-olfactory (not just related to smell) mechanisms for incoming interactions. That 'sniffing' or breathing-in drives brain activity has an evolutionary history. Unicellular organisms and plants take in volatile or gaseous substances in the air into their cells (this may be thought of as the precursor to inhalation). We know how sniffing is carried out in synchrony with whisking and vocalisation in mice and with echolocation in bats. Dr. Ofer Perl points out that olfaction is seen to be an ancient sense, which may have acted as a template for other, later senses and overall brain development in humans. The authors note that the word 'inspiration' in the Oxford Dictionary not only means drawing-in of breath but also the process of being mentally stimulated.

Yoga and meditation

While these authors do not directly address this question, we note that several scientists have suggested that yogic exercises (controlled breathing) lead to calmness and tranquility. In a set of experiments at Stanford University, USA, showed how a group of 175 neurons in the brain act as the breathing pacemaker in mice (used as models), and how controlled breathing promotes mental calmness in the animals (Yackle et al., Science, 355, 1411-1415, 2017, <doi:10.1126/science.aai7984>). Turning to humans, the paper by Dr. Bailey and colleagues from Monash University in Australia (https://doi.org/10.1011/396259) compared 34 people who practised meditation with 28 age/gender-matched 'controls'. The 'meditators' had an increased range of brain activities to meet tasks requirements, higher-order processes and sensory anticipation. Likewise, a group from Beijing, China (Ma et al., Frontiers in Psychology 2017 <doi:10.3389/fpsyg.2017.0084>) conducted a trial using 20 people, who were trained to breathe at the rate of 4 breaths/min (a la yoga), while 20 others were controls. The comparison revealed that the

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trained group had significantly lower levels of cortisol and improved sustained attention. Finally, a systematic critical review by Zaccaro and others (doi.org/10.3389/fnhum.2018.00353) concludes that slow breathing techniques enhance parasympathetic activity, emotional control and psychological well being.